MINIMUM PROPERTY REQUIREMENTS

FOR PROPERTIES OF

ONE OR TWO LIVING UNITS

LOCATED IN THE
STATE OF FLORIDA

FEDERAL HOUSING ADMINISTRATION

JACKSONVILLE, MIAMI AND TAMPA INSURING OFFICES

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1954/55 rev.
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This edition includes MPR
Revisions Nos. 1 through 48

U.S **FEDERAL HOUSING ADMINISTRATION**

JACKSONVILLE, MIAMI AND TAMPA INSURING OFFICES

FHA Form 2225. Revised June 1954

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R. R.

TABLE OF CONTENTS

	Section No.
Foreword	*Page IV*
Required Drawings and Specifications	1
Compliance Inspection Requirements	10
Suggested Construction Details	
General Acceptability Requirements	100
Minimum Planning Requirements	
Plot Planning Requirements	200
Building Planning Requirements	300
Minimum Construction Requirements	
Structural Requirements	400
Heating Requirements	500
Plumbing and Sanitation Requirements	600
Electrical Requirements	700
Lot Improvement Requirements	800

	Appendix
Tables of Maximum Allowable Spans for Wood	A
Definitions	B
Reference Standards	C
Detailed Heating Requirements	E
Index	*Page V*

Notice to Holders of This Book

This book has been bound so that it may be taken apart and placed in a standard loose-leaf binder. It will be revised from time to time by page or by numbered "MPR Revision." Those who are interested in keeping the book up to date may obtain such revisions from the FHA Insuring Office.

MPR Revisions Nos. 1 through 48 have been incorporated into this edition. Subsequent numbered MPR Revisions which may be issued will be applicable unless otherwise stated in the Revision.

These Federal Housing Administration "Minimum Property Requirements for Properties of One or Two Living Units" set forth minimum planning and construction requirements to apply to a residential property, including the land and all improvements thereon, which is offered or proposed to be offered to the Federal Housing Administration as security for an insured mortgage.

They are confined in their application to the individual property within its metes and bounds. They do not include requirements for off-site improvements except a general requirement for the provision of streets and essential utilities at the site at the time the property is accepted as security for an insured mortgage.

The requirements for residential properties containing more than two living units are found in the booklet entitled "Minimum Property Requirements for Properties of Three or More Living Units."

APPLICATION

Minimum Property Requirements is the title used to designate the "General Acceptability Requirements," the "Minimum Planning Requirements" and the "Minimum Construction Requirements" when referred to collectively. These Minimum Property Requirements apply in the following manner to each property consisting of one or two living units and covered by a single mortgage:

Proposed Construction shall comply with the "Minimum Property Requirements" in their entirety.

Existing Construction including any alterations or additions thereto and any property which is under construction at the time of approval for mortgage insurance shall comply with the "General Acceptability Requirements" and with the stated Objectives of the "Minimum Planning Requirements" and "Minimum Construction Requirements."

REFERENCE TO OTHER REQUIREMENTS AND STANDARDS

Multifamily Properties. The requirements contained in the booklet entitled "Minimum Property Requirements for Properties of Three or More Living Units" shall apply to *all* such multifamily properties regardless of the type of dwelling or dwellings included therein.

Neighborhood Requirements and Standards. Neighborhood Requirements contained in Land Planning Bulletin entitled "Neighborhood Standards" apply in their entirety to developments proposed on unimproved land under centralized control. For other developments they apply to the extent determined by the local FHA office. Local standards and other data related to neighborhood design, street improvements and other neighborhood features are also contained in this bulletin.

General.

1. Drawings and specifications submitted with applications for mortgage insurance shall completely indicate and describe all of the proposed work, including the sizes, grade and quality of materials and equipment to be incorporated in the improvements. To accomplish this the following shall be submitted.

Drawings.

2–A. Scale. Drawings shall be accurately drawn to a scale not less than that indicated below. It is preferred that sheets of drawings not exceed 14 inches in their vertical dimension.

2–B. Plot Plan.

NOTE.—*For a group of individual properties, the information required in this section may be shown in whole or in part on a development plan. For illustration, see related Exhibits Data Sheet in Land Planning Bulletin No. 3.*

Scale for individual plot plans shall be $\frac{1}{16}''$ *or* $\frac{1}{8}''=1'-0''$, *with latter preferred. See examples, following this section.*

1. Size of lot and the north point.
2. Widths of front, rear and side yards.
3. The following elevations (except as noted below) are required:
   a. First floor elevation in relation to:
      (1) Established street elevation at the extension of lot lines;
      (2) Existing grade elevations at each corner of lot;
      (3) Existing and finish grade elevations at each corner of dwelling.

Grades at the dwelling may be shown on the Exterior Elevations instead of on the Plot Plan.

b. Location, size and grade elevation of garage and other accessory buildings, driveways and walks.

NOTE.—*The elevations listed above may be omitted when the site terrain involves (a) no drainage problems, (b) no extra site improvements such as major terracing, retaining walls and steps, or (c) no foundation work in addition to that shown on the drawings.*

4. If the following features are involved, complete data regarding them shall be submitted:
   a. Location of steps, terraces and retaining walls.
   b. Easements and set-back requirements.
   c. Location of buildings on adjoining property within 5 feet of lot line.

2–B. Plot Plan. *Continued.*

d. Invert elevation of public sewer at point of connection and, if significant, location of or distance to point of connection. If individual sewage disposal systems are involved, include exhibits as required by the "Minimum Requirements for Individual Water-Supply and Sewage-Disposal Systems" for the area in which the property is located.

2–C. Floor Plans.

Scale to be ¼″=1′–0″.

1. Plans of all floors, basement and/or foundation to be included.
2. Show direction, size and spacing of all framing members.
3. Heating and cooling. Show on separate drawings or an appropriate floor plan:

a. Size and layout of heating units, pipes, ducts, registers, radiators, and any special arrangements.

b. Total maximum heat loss of dwelling and of each room in Btu per hour. When single overflow type of heater is used, give only heat loss of dwelling.

c. Domestic hot water equipment, size and layout.

4. Plumbing fixtures. Show location and size to scale.
5. Electric. Show location of all outlets and indicate the type.
6. Equipment. Show location and size to scale.

2–D. Exterior Elevations.

Scale to be ¼″=1′–0″. Front, rear and side elevations to be included showing: openings and sizes, wall finish materials, flashing, present and finish grades, depth of footings, finish floor and ceiling heights.

2–E. Cross Sections.

1. Show fully dimensioned cross section through exterior wall at scale of ½″=1′–0″ or larger including all details of construction from bottom of footings to highest point of roof necessary for complete roof construction indication.
2. Include fully dimensioned cross sections through stairwells, landings and stairs at scale of ¼″=1′–0″ or larger clearly showing all headroom conditions and details of all surrounding construction.
3. If house is more than one story in height or a finished attic space is intended, include complete cross section drawn at scale of ¼″=1′–0″ or larger.

2–F. Details.

Show details of all kitchen cabinets, shelving and all other cabinet work at scale of ¼″=1′–0″ or larger and describe on Form 2005 unless of customary construction. Include details at a scale of ½″=1′–0″ or larger of all critical points in the construction and of all unusual or unconventional combination of materials. Also include cross section through fireplace if any at a scale of ½″=1′–0″ or larger.

Specifications.

3–A. The term "specifications" where used in this booklet means the data provided on FHA Form 2005, Description of Materials, plus all applicable FHA requirements including the applicable FHA Minimum Construction Requirements and any applicable FHA Engineering bulletin or other related bulletin.

3–B. The use of FHA Form 2005, Description of Materials, is required. It must be completely filled out in strict accordance with the instructions printed thereon. If in the opinion of the Chief Underwriter certain items of materials or equipment must exceed the minima prescribed by the Minimum Construction Requirements or described on Form 2005, the pertinent items will be appropriately revised by FHA during consideration of the application.

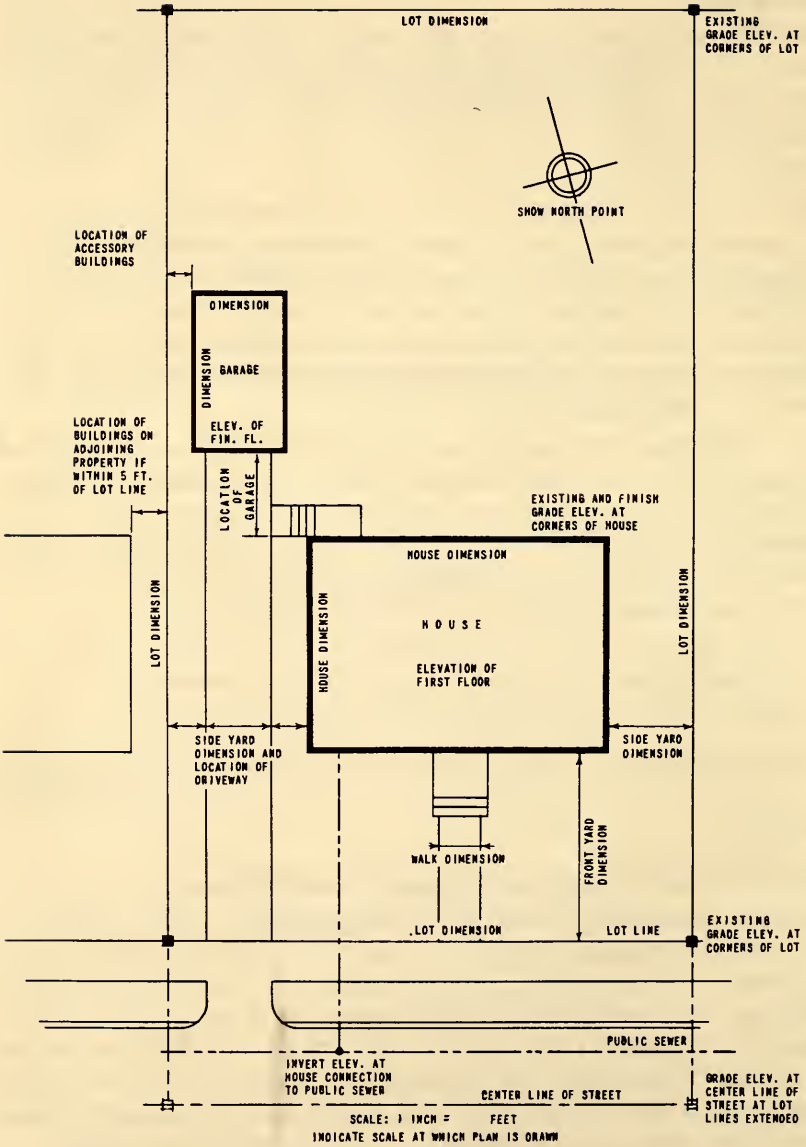
3–C. FHA Form 2005 may be obtained without charge from any approved mortgagee or from the FHA Insuring Office. The reproduction by others of this form is permitted only when the size, format, printing, text, folding and punching are identical to the official form in current use and when the following items are excluded from the facsimile:

1. The line "Federal Housing Administration" in the heading;
2. "FHA Form 2005" and the line immediately beneath;
3. The Budget Bureau number and approval expiration date; and
4. The U. S. Government imprint and reference numbers.

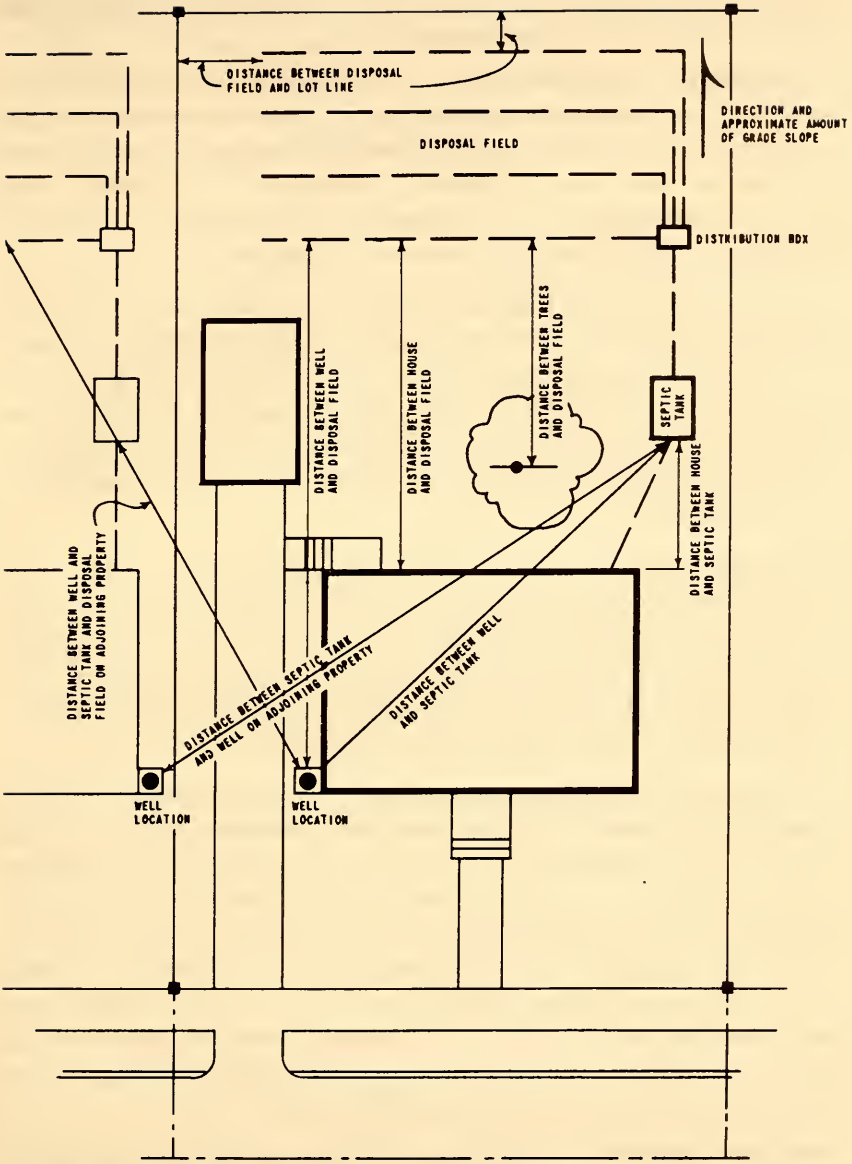
3–D. Reproduction of Form 2005 other than as described above will be in violation of a Federal statute prohibiting the reproduction of Government forms, etc.

Individual Water-Supply and Sewage-Disposal Systems.

4. If an individual water-supply or sewage-disposal system or both are involved the proposed installations must be completely illustrated and described in separate drawings and specifications. Requirements for these drawings and specifications are listed under the heading "Required Exhibits" in a separate FHA booklet entitled "Minimum Requirements for Individual Water-Supply and Sewage-Disposal Systems" for the area in which the property is located. This booklet may be obtained without charge from any approved mortgagee or from the FHA Insuring Office.


LOT DIMENSION
EXISTING GRADE ELEV. AT CORNERS OF LOT
SHOW NORTH POINT
LOCATION OF ACCESSORY BUILDINGS
DIMENSION
DIMENSION
GARAGE
ELEV. OF FIN. FL.
LOCATION OF BUILDINGS ON ADJOINING PROPERTY IF WITHIN 5 FT. OF LOT LINE
LOCATION OF GARAGE
EXISTING AND FINISH GRADE ELEV. AT CORNERS OF HOUSE
HOUSE DIMENSION
HOUSE
ELEVATION OF FIRST FLOOR
HOUSE DIMENSION
LOT DIMENSION
LOT DIMENSION
SIDE YARD DIMENSION AND LOCATION OF DRIVEWAY
SIDE YARD DIMENSION
WALK DIMENSION
FRONT YARD DIMENSION
LOT DIMENSION
LOT LINE
EXISTING GRADE ELEV. AT CORNERS OF LOT
PUBLIC SEWER
INVERT ELEV. AT HOUSE CONNECTION TO PUBLIC SEWER
CENTER LINE OF STREET
GRADE ELEV. AT CENTER LINE OF STREET AT LOT LINES EXTENDED
SCALE: 1 INCH = FEET
INDICATE SCALE AT WHICH PLAN IS DRAWN

Example Plot Plan No. 1


DISTANCE BETWEEN DISPOSAL FIELD AND LOT LINE
DISPOSAL FIELD
DIRECTION AND APPROXIMATE AMOUNT OF GRADE SLOPE
DISTRIBUTION BOX
DISTANCE BETWEEN WELL AND DISPOSAL FIELD
DISTANCE BETWEEN HOUSE AND DISPOSAL FIELD
DISTANCE BETWEEN TREES AND DISPOSAL FIELD
SEPTIC TANK
DISTANCE BETWEEN HOUSE AND SEPTIC TANK
DISTANCE BETWEEN WELL AND SEPTIC TANK AND DISPOSAL FIELD ON ADJOINING PROPERTY
DISTANCE BETWEEN SEPTIC TANK AND WELL ON ADJOINING PROPERTY
DISTANCE BETWEEN WELL AND SEPTIC TANK
WELL LOCATION
WELL LOCATION

When individual water-supply and sewage-disposal systems are proposed the *additional* information shown above is required on the plot plan. The above plot plan is diagrammatic; it is not to be construed as showing acceptable location or type of well, septic tank and sewage disposal.

Example Plot Plan No. 2

COMPLIANCE INSPECTION REQUIREMENTS

NOTE.—*The Compliance Inspections hereafter described are made by the Federal Housing Administration in its own interest.*

10. Objective. *Compliance inspections are made by the Federal Housing Administration to determine whether construction is in compliance with the provisions of the commitment for mortgage insurance. Commitments for insurance require the completion of construction in accordance with approved drawings and specifications and in a manner equal to or exceeding the applicable FHA Minimum Construction Requirements.*

11. Drawings and Specifications. The drawings and FHA Form 2005, Description of Materials (also any required separate exhibits for individual water-supply and sewage-disposal systems), returned to the mortgagee with the commitment and identified as the *FHA SET* shall be kept on the site and shall be made available to FHA inspectors at all times. If inspection cannot be made because these documents are not available, reinspection may be required.

12. Identification of Property. The FHA serial number stamped on the drawings shall be posted on the site and so located and made that it can be read from the street. The number may be marked on a board approximately 8 by 30 inches, with lumber-marking crayon or black paint. Inability to identify the property for inspection because the serial number is not posted may cause delay and will require reinspection.

13. Requests for Compliance Inspection. The builder must notify the mortgagee, who in turn shall notify the FHA Insuring Office in writing, stating the date when construction will be ready for each inspection required by the commitment. In mailing these notifications, allowance shall be made for the time required in the mail, for assignment of inspections and for travel by the inspector. Construction shall have progressed to the stage appropriate to the inspection requested otherwise no inspection will be made and reinspection will be required. Delayed requests for the inspection may require uncovering of concealed work and reinspection. Telephone requests for inspections will not be accepted by FHA.

14–A. First Compliance Inspection. The commitment may require the First Compliance Inspection to be made when excavation is completed; when foundations are completed; or at another stage more suitable to the construction or to the soil conditions.

1. *Excavation Completed.* When the First Compliance Inspection is requested at the time excavation is completed, the items set forth below shall

be complete and visible for examination by the FHA inspector:

a. All excavation for footings and foundations.

b. Temporary forms for footings and any reinforcing steel required.

c. Batter boards in place and wall lines established.

d. Elevation of the finish first floor established on a batter board, stake or other well-defined marker indicating its relationship to elevation of top of street curb or crown of street as determined by authorities having jurisdiction.

2. *Foundations Completed.* When the First Compliance Inspection is requested at the time foundations are completed, the items set forth below shall be complete and visible for examination by the FHA inspector:

a. All footings, foundation walls, piers, and any other foundation work.

b. No backfill shall have been placed.

c. Dampproofing and foundation drainage if required.

d. Elevation of the finish first floor established on a batter board, stake or other well-defined marker indicating its relationship to elevation of top of street curb or crown of street as determined by authorities having jurisdiction.

14–B. Intermediate Compliance Inspection. An Intermediate Compliance Inspection is required when structural work must be installed after a regular inspection and will be concealed before construction has progressed to the succeeding inspection stage. An Intermediate Compliance Inspection shall be requested for the date when the work will have been installed and will be ready for inspection. The stages at which an Intermediate Compliance Inspection must be requested are:

1. When a First Compliance Inspection has been scheduled for examination of excavation for a slab on the ground and an additional inspection of work preparatory to pouring the slab is essential.

2. When concrete slab floor of porches and terraces will be installed, after the Second Compliance Inspection, an Intermediate Compliance Inspection is required to be requested when forms and reinforcing steel are in place ready for pouring concrete.

14–C. Second Compliance Inspection. When the Second Compliance Inspection is requested, the items set forth below shall be complete and visible for examination by the FHA inspector.

1. The structure enclosed, roofing dried-in, partition framing in place, but structural members exposed.
exposed.

2. Roughing-in for heating, plumbing and electrical work.

3. Any construction below the superstructure which was not installed at the time of the first inspection.

14 – C. Second Compliance Inspection. *Continued.*

4. In structures with basements, under-bed for finish basement floor as well as any reinforcing bars and subfloor drains, shall be in place and exposed.
5. Footings and foundations for stoops, porches and terraces with reinforcing for slabs in place.
6. If an individual water-supply or sewage disposal system is involved, the installation should be completed, ready for backfill, and connections made to the plumbing system within the structure.

14–D. Third Compliance Inspection. When the Third Compliance Inspection is requested, the items set forth below shall be complete in accordance with all approved exhibits and ready for examination by the FHA inspector.

1. The dwelling structure completed, cleaned and ready for occupancy.
2. Easily removable real estate items included in the commitment in place.
3. Finish grading, seeding, sodding and landscape planting as shown or described by the exhibits or required by the commitment.
4. Walks and drives, including their extension to the public walk, curb or pavement, and utilities including their extension and connection to offsite public mains.
5. Fences, garden walls, retaining walls and other accessory structures shown or described by the exhibits or required by the commitment.
6. Offsite improvements required by specific conditions of the commitment.
7. Arrangements shall be made to have the house open for the inspector.
8. If the dwelling is furnished, the mortgagor or his representative shall be present.

14–E. Repair Compliance Inspection. If Repair Compliance Inspection is required by the commitment, request for inspection shall be made when required repairs or alterations are completed, or at the stage scheduled in the commitment. If ingress to dwelling is necessary for inspection the dwelling shall be open and if furnished, the mortgagor or his representative shall be present.

14–F. Reinspection. A reinspection is a repeat of any previous inspection or attempted inspection which is required by some action or omission by the mortgagee, mortgagor or builder. A reinspection will not be made automatically but must be requested in writing by the mortgagee. The Compliance Inspection Report, Form 2051, of an inspection will indicate when a reinspection is required, including the circumstances described below:

1. Incorrect address of property to be inspected.
2. Property not identified because FHA serial number was not posted.
3. FHA approved drawings and description of materials not available at site.
4. House locked or admission refused.
5. Dwelling furnished and mortgagor or his representative not present.

6. Improper, premature, or belated request for inspection.
7. Required corrections, which would be concealed at next regular inspection stage, or work essential to acceptance has not been completed.
8. An inspection revealed the need for uncovering concealed work to permit its examination.
9. A Third Compliance Inspection revealed unacceptable or incomplete items, the correction or completion of which is essential to acceptance.
10. Upon completion of construction covered by a Mortgagee's Assurance of Completion, Form 2300.

14–G. Optional Inspection. An Optional Inspection is an unscheduled inspection made by FHA without request for the purpose of observing construction such as roof application, lathing, and similar items which cannot be inspected at a regular inspection stage.

15. Compliance Inspection Reports. Any unapproved copy of the Compliance Inspection Report, Form 2051, left at the site is for the contractor's convenience and is subject to change. The official Compliance Inspection Report is forwarded to the mortgagee. Inquiries relating to this report should be directed to the mortgagee.

16. Correction of Construction.

1. Items which do not comply with the conditions of the commitment for insurance and which require correction are noted on the Compliance Inspection Report.
2. Correction of construction which does not comply with the provisions of the commitment is required before the property will be accepted as security for a mortgage to be insured.
3. When uninstalled materials or equipment are observed during an inspection, and their installation may result in noncompliance the builder may be cautioned against their inclusion in the construction.
4. Correction of construction in noncompliance with the commitment may be required at any time previous to acceptable completion of building improvments. The omission from any report of items in noncompliance at any stage of construction shall not be construed as acceptance of work previously performed.
5. Major variations from the approved drawings and Description of Materials or extensive noncompliance with the Minimum Construction Requirements will result in termination of inspections until the mortgagee advises that correction has been made, and requests reinspection or requests reconsideration of the commitment on the basis of the work as built, and receives FHA acceptance thereof.
6. The Chief Underwriter may require test data as outlined in Section 401–F–2 when essential to the determination of compliance.

17. Uncovering Concealed Work. Construction concealed before inspection with the result that compliance cannot be determined, must be uncovered sufficiently so that a determination of acceptability can be made. The Compliance Inspection Report, Form 2051, will indicate when uncovering is required and the location and extent of such uncovering.

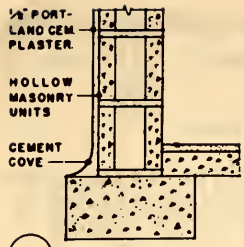
18. Delayed Completion. When completion of certain items is prevented by conditions beyond control, the mortgage may be endorsed for insurance if the dwelling is essentially complete, safe and habitable and if the mortgagee executes FHA Form 2300, Mortgagee's Assurance of Completion. This shall provide for completion within six months or not later than the date when the causes of delay will permit completion, and must also provide for the mortgagee to withhold an amount equal to two times the FHA estimate of the cost of completing the deferred items, but not less than $100, to assure completion by the date specified by FHA. Upon completion a request for reinspection must be submitted by the mortgagee.

19. Termination of Inspections. When extensive noncompliance is discovered and it appears that the contractor is unwilling or unable to make correction, compliance inspections are terminated. Under these circumstances the property will not be eligible for mortgage insurance under the terms of the commitment.

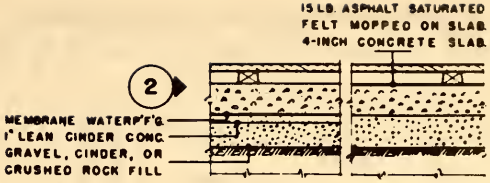
20. Beginning of Construction.

1. The National Housing Act provides the maximum amount and term for mortgages on properties involving proposed construction which were approved for mortgage insurance prior to the beginning of constuction. Consequently, if construction is begun before the date of commitment, it may be necessary to issue a new commitment in a lesser amount or term.
2. The beginning of construction is interpreted as the placement of permanent construction, such as the pouring of footings or any work beyond the stage of excavation. This interpretation does not include land preparation, land clearing, grading, filling, excavation for basement, excavation for footings and for piers or foundations, erection of temporary forms, the installation of piling under proposed subsurface footings, the installation of sewer, gas and water pipes, electric or other service lines from the street to the dwelling, and the existence on the property of accessory buildings such as garage or sheds which are not occupied or designed as dwelling units and which are not a part of the main structure.

21. Certification of Construction. When a special method of construction involves the concealment of certain elements of construction prior to their installation in the structure, thereby precluding examination thereof, the manufacturer's certification as to conformance with FHA requirements with respect to the special features of the construction will be required.



1 · FOOTING ·



· WOOD · FLOOR · OVER ·
· SLAB · ON · GROUND ·

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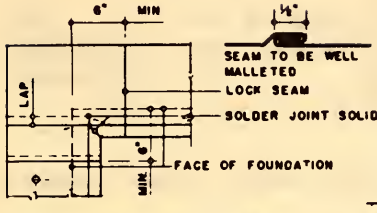

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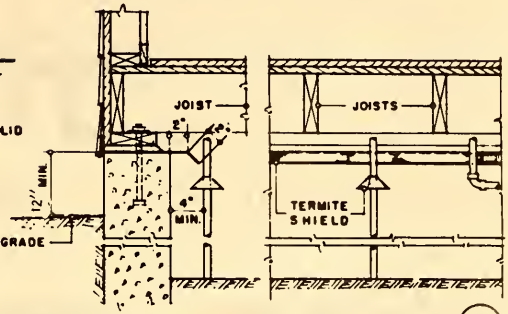

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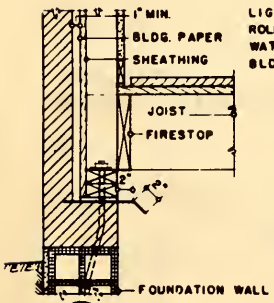
· TERMITE · SHIELD · DETAILS ·



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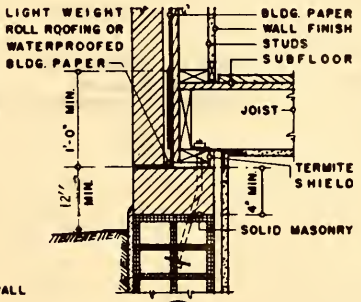

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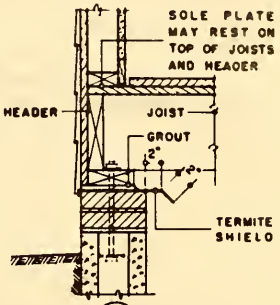

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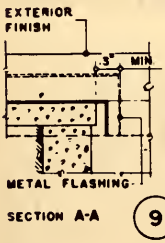

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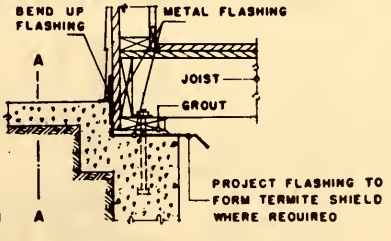
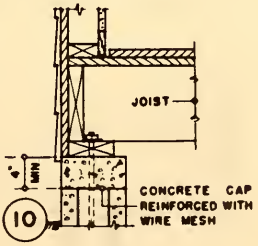
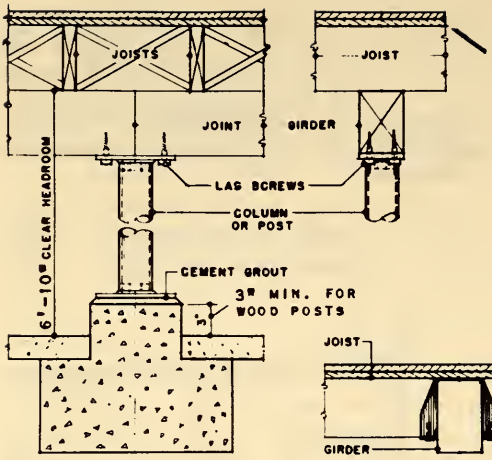




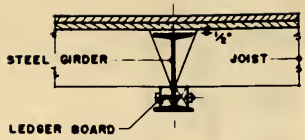
10

FLASHING · AT · FILLED · PORCH · OR · TERRACE ·

SILL · CONSTRUCTION

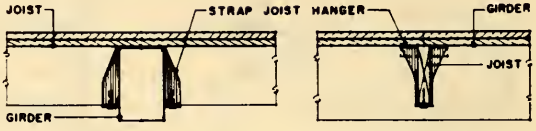


·COLUMN · FRAMING· (11)

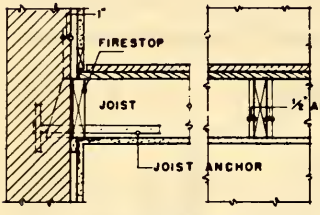


·JOISTS · FRAMING · ON · ·BOTTOM · FLANGE · OF · ·STEEL · GIRDER·

(12)

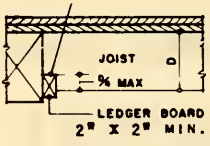


(13) ·METAL · JOIST · HANGER·



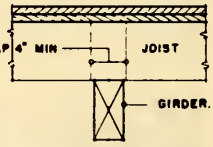
·JOISTS · FRAMING · ·INTO · MASONRY · WALLS·

(14)



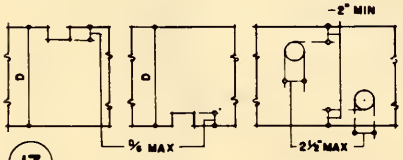
·JOIST · FRAMING · INTO GIRDERS, HEADERS, & TRIMMERS.

(15)



·JOIST · LAP · ·OVER · GIRDER·

(16)



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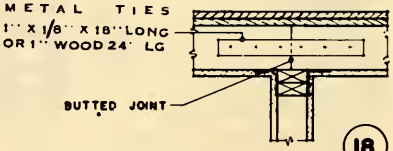
·CUTTING · JOISTS · FOR · PIPING·



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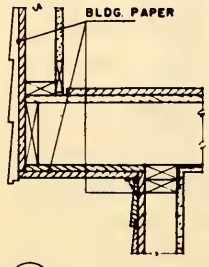
·JOIST · TIE · AT · BUTTED · JOINT·



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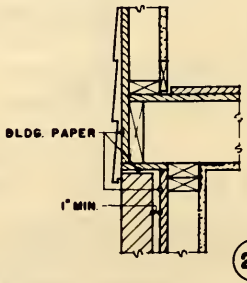
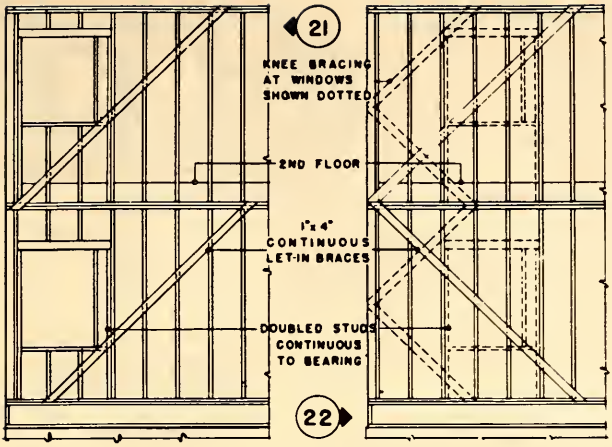
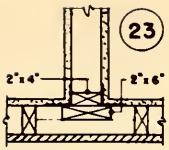


(20)

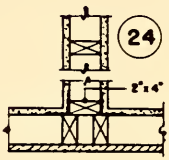
·CANTILEVERED · OVERHANG·



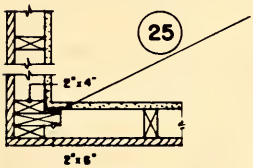
·ELEVATION · OF · CORNER · BRACING·



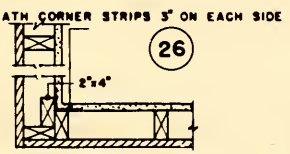
PARTITION · CORNER·



PARTITION · CORNER·



·CORNER · POST·



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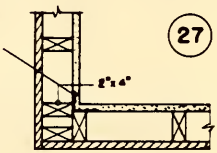

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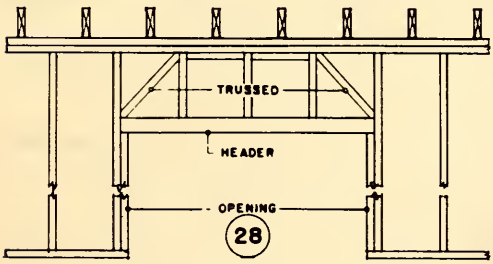
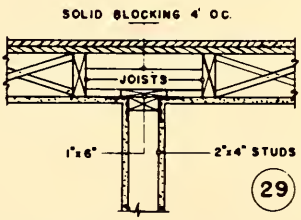
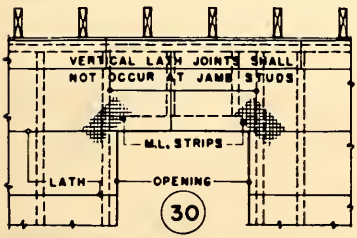


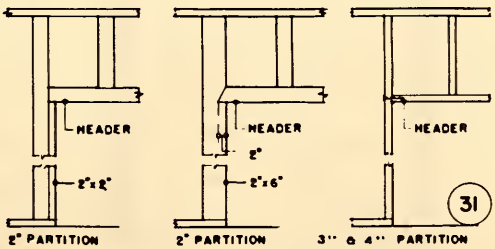
·TRUSSED · HEADER · FOR · WIDE · OPENINGS·



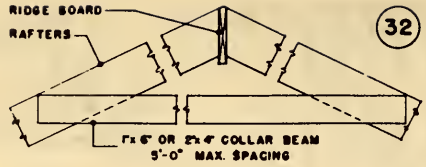
·NONBEARING · PARTITION · PARALLEL · TO · CEILING · JOISTS·



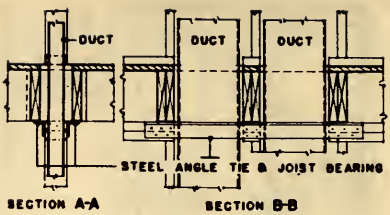
·BOARD · LATH · JOINTING · AT · HEAD · OF · OPENING·

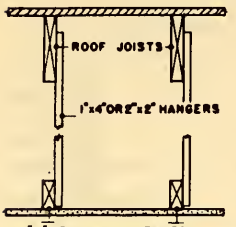


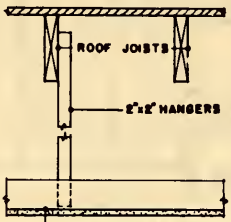
·FRAMING · OF · OPENINGS · IN · NONBEARING · PARTITIONS·



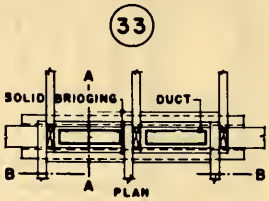
·RIDGE·BOARD·AND·COLLAR·BEAM·



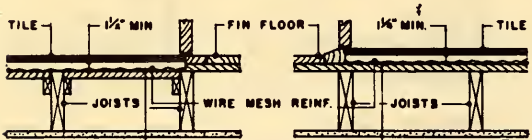




34 ·HUNG·CEILING·FRAMING· 35

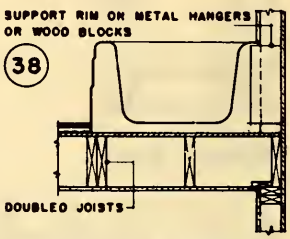


·JOIST·BEARING·AND·
·PLATE·REINFORCING·

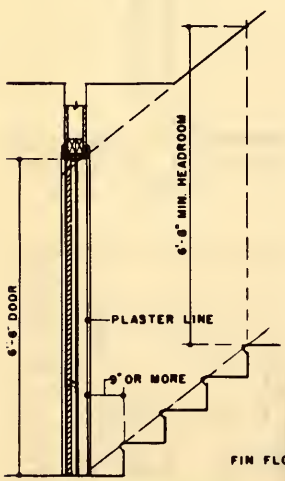


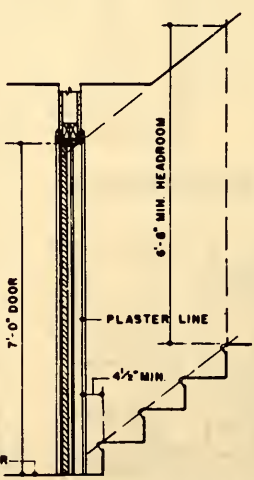
36 37

·TILE·FLOOR·ON·WOOD·CONSTRUCTION·

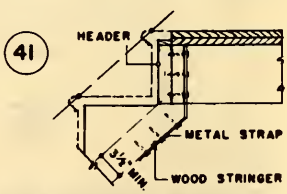


·BATH·TUB·SUPPORT·

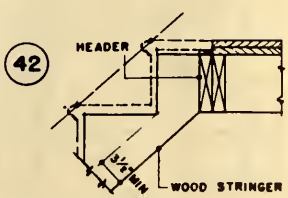




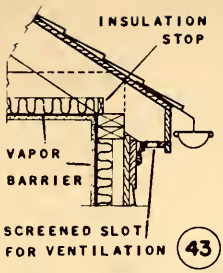
39 ·HEADROOM·AT·DOOR·NEAR·
·FOOT·OF·MAIN·STAIRS· 40



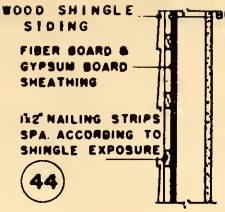
·STRINGER·FRAMING·
·AT·HEAD·OF·STAIRS·



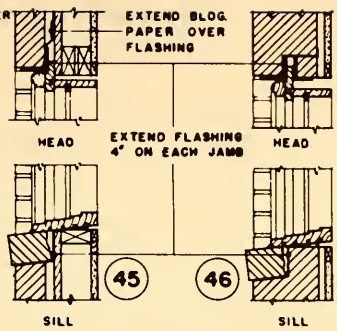
·STRINGER·FRAMING·
·AT·HEAD·OF·STAIRS·



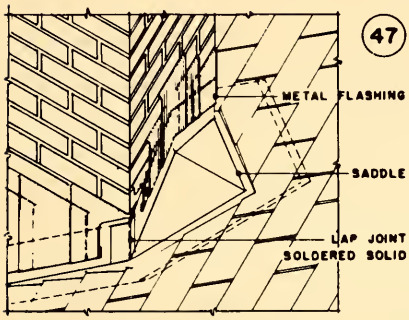
EAVE DETAIL·



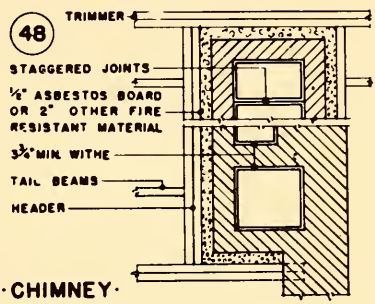
·NAILING · STRIPS·
·OVER·FIBER·AND·
·GYPSUM·SHEATHING·



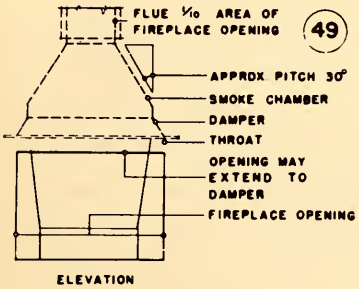
WINDOW · FLASHING·

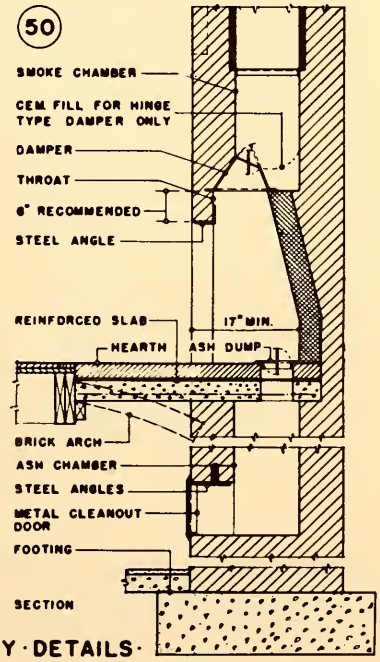


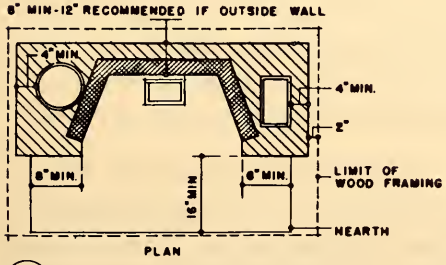
·CHIMNEY · SADDLE · & · FLASHING·



·CHIMNEY·







51

·FIREPLACE·AND·CHIMNEY·DETAILS·

GENERAL ACCEPTABILITY REQUIREMENTS

GENERAL

100. These General Acceptability Requirements together with the Administrative Rules and Regulations are the eligibility rules and apply to all nonfarm one- and two-family properties whether proposed or existing construction.

SITE CONDITIONS

101. The property shall not be subject to hazards such as objectionable smoke, noxious odors, unusual noise, the probability of subsidence, flood or erosion.

THE PLOT

102. All land offered as security for an insured mortgage shall comprise a single plot except that a dwelling site with a secondary site for an appurtenant garage or for other use essential to the dwelling will be acceptable provided the two plots are in such proximity as to comprise a readily marketable real estate entity.

ACCESS

103–A. Access to the Plot. Direct vehicular access to the property shall be provided by means of an abutting improved public street or way or improved and permanently maintained private street or way which is protected by a permanent easement. Sole vehicular access shall not be by an alley. The width and construction of streets or ways shall be suitable for the vehicular traffic requirements of the properties served. Dead end streets shall include adequate vehicular turning space.

103–B. Access to the Dwelling. Each dwelling shall be provided with a means of access for the removal of garbage and trash and for the delivery of fuel. Access for these services shall be provided at the rear of a row dwelling by means of an alley, easement or open passage through dwelling, unless provided for by other satisfactory and acceptable means.

103–C. Access to Living Units. A means of access to each living unit shall be provided without passing through any other living unit. Acceptable means of access to the rear yard shall be provided for each living unit without passing through any other living unit.

TYPES OF ELIGIBLE DWELLINGS

104–A. The types of dwellings eligible for consideration are: Detached, semidetached, row and end-row dwellings. Each of these types may contain one or two living units.

104–B. A semidetached, row or end-row dwelling shall be separated from an adjoining dwelling or dwellings by a party or lot-line wall extending the full height of the building. The party or lot-line walls shall be designed as bearing walls, be constructed of masonry and have no through openings. A party wall shall be so constructed that the dwelling on either side may be razed without impairment of structural stability of the wall.

104–C. Each dwelling must be capable of individual use and maintenance without trespassing upon adjoining properties. Utilities and service facilities must be independent for each property.

METHOD OF DETERMINING NUMBER OF LIVING UNITS

105–A. A dwelling shall provide living facilities for at least one family but not more than two families. If more than two families are involved see Minimum Property Requirements for Properties of Three or More Living Units.

105–B. In determining the number of living units, the following rules shall be used in considering properties with living facilities in addition to the required living unit for one family as set forth in 302. These rules shall also be used to determine the number of living units contained in any property submitted as security for an insured mortgage, since application of the Minimum Property Requirements for properties of one or two living units, or those for properties of three or more living units, will depend upon such determination.

105–C. A habitable room or group of habitable rooms containing cooking facilities, or provisions for such facilities, shall be counted as a living unit whether or not designed for use of occupants such as janitors, caretakers, servants, or guests, and whether or not they are included in the main building. However, disconnected or isolated habitable rooms, without cooking facilities or provisions for such facilities, which are for use of servants or guests, and which are obviously auxiliary to a living unit shall not be counted as a separate living unit.

105–D. Other arrangements of habitable rooms, single or grouped, but without cooking facilities or provisions for such facilities, shall be counted as separate living units if such rooms are not designed as, or obviously not auxiliary to, or are not connected with a living unit but, in fact, constitute a separate living unit.

NONRESIDENTIAL USE

106–A. Any nonresidential use of the property shall be subordinate to the residential use and character of the property.

106–B. The area of the dwelling and accessory buildings including storage space, designed or used for nonresidential purposes, shall not exceed 25 percent of the total floor area. The total floor area shall include the area of all floors and such portions of basements and finished attics designed or used for both residential and nonresidential purposes. The computed nonresidential floor area shall include all space which is essential to the proper functioning of the nonresidential area. If hallways or similar spaces serve both residential and nonresidential areas, they shall be considered nonresidential area in determining the above percentage.

106–C. A property, any portion of which is designed or used for nonresidential purposes, is ineligible if the type or extent of the nonresidential use is inharmonious with the residential character of the property for family occupancy. In addition to most business and commercial enterprises and certain types of professional activities, inharmonious uses include commercial rooming or boarding houses, tourist houses or cabins, club houses, sanitariums, and fraternity houses.

106–D. A property which is designed or used for the manufacture, handling or storage of highly combustible or inflammable materials is ineligible.

SERVICES AND FACILITIES

107–A. Each living unit shall contain provisions for each of the following:

1. A continuing supply of safe and palatable water;
2. Sanitary facilities and a safe method of sewage disposal;
3. House heating adequate for healthful and comfortable living conditions;
4. Domestic hot water in quantity adequate to serve appropriate fixtures;
5. Electricity for artificial lighting and to serve electrical equipment used in the dwelling.

DEFECTIVE CONDITIONS

108. Unacceptable construction, or evidence of continuing settlement, dampness, leakage, decay, termites, or other conditions impairing the safety or sanitation of the dwelling, shall render the property ineligible as security for an insured mortgage until such defects or conditions have been remedied and the probability of further damage eliminated.

MINIMUM PLANNING REQUIREMENTS

PLOT PLANNING REQUIREMENTS

GENERAL

200–A. Drawings and Specifications. For required drawings and specifications, see **1** to **4.**

200–B. Compliance with Local Ordinances and Regulations.

1. The development and use of land shall conform to all applicable laws, ordinances and regulations (including deed restrictions and covenants running with the land) which relate to the utilization of land.
2. Where change in present zoning status is required, evidence of the acceptability of such change to local authorities must be submitted prior to the acceptance of an application for processing by this Administration.
3. The minimum requirements established herein shall not be construed as lowering the standards established by the local laws, ordinances, or regulations. Whenever such local requirements contain more stringent provisions than any of the minimum requirements of the Federal Housing Administration, the more stringent requirements shall govern.
4. The Federal Housing Administration does not assume responsibility for determining compliance with local requirements.

200–C. Optional Requirements. These requirements are essentially minimum, consequently the Chief Underwriter may require compliance with higher requirements than those contained herein, to obtain conformance with standards consistent with the type and size of property under consideration.

200–D. Changes After Commitment. No changes, except for acceptable minor variations from the plot plan arrangement upon which a commitment has been based, will be permitted without first obtaining written approval from the FHA Insuring Office.

MINIMUM LOT AREAS

201–A. Objective. *The objective of lot area requirements is to provide for adequate open area on the property to assure privacy, adequate natural light and ventilation to each living unit, and to provide sufficient area for outdoor uses essential to the type of dwelling under consideration.*

201–B. Lot Areas. Lot areas shall be not less than the following:

1. Detached dwelling, one-family: 5,000 square feet.
2. Semidetached dwelling, one-family: 3,000 square feet.
3. End-row dwelling, one-family: 3,000 square feet.

4. Row dwelling, one-family: 2,000 square feet.
5. Two-family dwellings: 6,000 square feet.
6. In instances where existing platting and improvements preclude compliance with 1 through 5 inclusive above, exceptions may be made when acceptable to the Chief Underwriter.
7. When individual water supply or sewage disposal or both are involved, lot areas shall be adequate to comply with the FHA "Minimum Requirements for Individual Water-Supply and Sewage-Disposal Systems", for the area in which the property is located, but in no case less than the above minimums.

LOT COVERAGE

202–A. Objective. *The objective of coverage requirements is to assure sufficient open area on the lot in relation to the area covered by buildings to assure privacy, adequate natural light and ventilation to each living unit, and sufficient space for laundry drying, gardening, landscaping, outdoor living or other uses considered essential to the type of dwelling under consideration.*

202–B. Lot Coverage. Maximum area of plot which may be used for:
1. Detached dwelling on:
   a. Interior lot, 30 percent.
   b. Corner lot, 35 percent.
2. Semidetached dwelling, 35 percent.
3. End-row dwelling, 35 percent.
4. Row dwelling, 35 percent.

202–C. Deduction from Building Area. When a one-story attached or detached garage or carport is located on the same plot with the dwelling, the area of the garage or carport not to exceed 200 square feet for a one-car garage or carport and 400 square feet for a multicar garage or carport may be deducted from the total building area in computing the lot coverage. No deduction permitted for a built-in garage or for garage having habitable rooms above.

YARDS—General

203–A. Objective. *The objective of yard requirements is to obtain sufficient distances between the dwelling on the subject property and obstructions on adjoining properties to assure privacy, adequate natural light and air, and convenient access to the dwelling, and to provide for circulation around the dwelling and for such uses of the yard spaces as are considered essential to the type of dwelling under consideration.*

203–B. Determination of Continued Assurance of Open Spaces. Location of future buildings on adjoining unimproved properties shall be con-

203 – B. Determination of Assurance of Open Spaces. *Continued.*

sidered as assured when fixed by codes, laws, restrictions, recorded permanent easements, or by established and accepted practice in the neighborhood in which the property is located.

203–C. Determination of Compliance When Yard Adjoins an Alley. Width of side and rear yard adjoining an alley shall be measured from the building to the near side of the alley.

203–D. Determination of Yard Requirements on Corner Lot. The narrower side of the lot abutting a street shall be considered the front regardless of the location of the principal entrance of the dwelling.

203–E. Determination of Yards on Irregularly Shaped Lots. When any wall of a dwelling located on an irregularly shaped lot does not parallel the lot line which the wall faces, compliance with the minimum yard requirements shall be determined as follows:

1. If the wall contains a required window of a habitable room, the yard width at the required window shall comply with the applicable requirements.
2. In all cases the yard width at every point shall be at least equal to the minimum required for front, rear or side yards, whichever is applicable. The same principle shall apply in determining the width of courts and distance between buildings on the same plot, when walls are not parallel.

FRONT YARDS

204. Minimum distance from front line of dwelling to building line on opposite side of street, 70 feet.

REAR YARDS

205. Minimum distance from main building to rear lot line, 15 feet.

SIDE YARDS. *Applicable to Both Interior and Corner Lots.*

206–A. Detached Dwellings.

1. Sum of side yards: all cases, minimum 15 feet.
2. Side yards faced by required windows of habitable rooms: minimum width of each side yard 7′–6″, except that a minimum width of 5 feet is permitted in connection with residential developments when established controls provide assurance that the sum of the side yards and the distance between buildings will be a minimum of 15 feet.

3. All other side yards: Minimum width 5 feet.

NOTE.—*In instances where existing platting and improvements preclude compliance with 1, 2, and 3 above, exceptions may be made when acceptable to the Chief Underwriter.*

206–B. Semidetached Dwellings. Width of side yards: Minimum 10 feet.

206–C. End-row Dwellings. Width of side yard: Minimum 10 feet.

206–D. Garages and Carports.

1. One-story detached or attached garages or carports: Minimum 3 feet.
2. One-story attached garages or carports, including those connected to the main dwelling by a roofed terrace or porch: Minimum 5 feet.

206–E. Driveway. In all cases when a side yard is used for a driveway, that side yard shall be not less than 10 feet wide.

COURTS

207–A. Objective. *The objective of court requirements is to assure adequate natural light and ventilation to all rooms facing on courts without impairment of privacy.*

207–B. Outer Courts.

1. When a required window of a habitable room opens on an outer court and:
   a. Faces an open end of court: minimum court width, 5 feet.
   b. Faces an existing or allowable future side wall of court, less than two stories high: minimum court width, 10 feet; for dwellings two stories high, 12 feet.
2. When nonrequired windows in habitable rooms open on a court: minimum court width, 6 feet.
3. The requirements in 1 and 2 do not apply when the depth of an outer court is 50 percent or less of the width.

207–C. Inner Courts. Inner courts are not acceptable as a means of providing required natural light and ventilation.

207–D. Irregularly Shaped Courts. See 203–E.

DISTANCE BETWEEN BUILDINGS ON SAME PLOT

208–A. Objective. *The objective of requirements for distance between buildings is to provide adequate natural light and ventilation to all rooms with windows facing the opposing buildings without impairment of privacy.*

208–B. Distance between a dwelling wall containing a required window of a habitable room and another dwelling or an accessory building: Minimum 15 feet.

208–C. Distance between building walls in all other cases: Six feet minimum.

208–D. When opposite walls are not parallel, see 203–E.

DRIVEWAYS AND WALKS

209. See Lot Improvement Requirements, Sec. 800.

GENERAL

300–A. Drawings and Specifications. For required drawings and specifications, see **1** to **4**.

300–B. Compliance With Local Regulations.

1. All improvements of the land including buildings and all appurtenances thereto shall conform to all applicable laws, ordinances and regulations (including deed restrictions and covenants running with the land) which relate to the safety and sanitation of the buildings. The minimum requirements established herein shall not be construed as lowering the standards established by the local laws, ordinances, or regulations. Whenever such local requirements contain more stringent provisions than any of the minimum requirements of the Federal Housing Administration, the more stringent requirement shall govern.
2. The Federal Housing Administration does not assume responsibility for determining compliance with local requirements.

300–C. Optional Requirements. These requirements are essentially minimum, consequently the Chief Underwriter may require compliance with higher requirements than those contained herein, to obtain conformance with standards consistent with the type and size of property under consideration.

300–D. Changes After Commitment. No changes, except for acceptable minor variation, from the drawings and specifications of the dwelling upon which a commitment has been based, will be permitted without first obtaining written approval from the FHA Insuring Office.

LIGHT AND VENTILATION

301–A. Objective. *The objective of light and ventilation requirements is to (a) assure satisfactory and healthful living conditions by providing natural light and ventilation in sufficient volume, proportioned to the size and intended use of the rooms; and (b) provide sufficient ventilation to spaces, such as attics and basementless areas, to prevent conditions conducive to decay and deterioration of the structure.*

301–B. General.

1. Natural light and ventilation shall be provided in all habitable rooms by means of windows or their equivalent located in outside walls.

301 – B. General. *Continued.*

2. Windows which provide all or part of the natural light and ventilation required herein are considered required windows. All windows in addition to these are considered nonrequired windows.

3. The area of glazed portions and area of openings of doors in exterior walls may be included in determining compliance with the following requirements, except that an exterior door in a habitable room will not be acceptable as the only means of providing ventilation.

4. Any glazing material, such as glass block, may be used to provide natural light if the area is sufficient to admit an amount of light equivalent to that transmitted by the required area of clear glass; in no case less than the area required for clear glass.

5. In determining required glass area, measure the actual glass area disregarding muntins.

6. Row dwellings shall be not more than two habitable rooms deep from outside wall to outside wall except for the condition permitted by 301–D.

301–C. Habitable Rooms. Required windows in each habitable room:

1. Total glass area: not less than 10 percent of floor area of room.
2. Ventilating area: not less than,
   a. Four percent of floor area of room with no exterior door; or
   b. Two percent of floor area of room with an exterior door.

3. If windows open on covered porches and terraces, or are in rooms any portion of which is more than 18 feet from a window, the glass area shall be not less than 15 percent of the floor area of the room.

4. If windows open on a glass enclosed porch, the glass area of required windows shall be not less than 20 percent of the floor area of the room; such windows shall not be included in determining required ventilating area unless determined to be otherwise acceptable to the Chief Underwriter for a specific property.

301–D. Alcoves.

1. Unless separately lighted and ventilated by windows which provide the required glass and ventilating area, include any alcove adjoining a habitable room as part of that room in computing required glass and ventilating area.

2. An alcove may receive light and ventilation from the windows of an adjoining habitable room only when the common wall between the alcove and the habitable room contains an opening, the area of which is not less than 80 percent of the area of the entire wall on the alcove side.

301–E. Bathroom or Water Closet Compartment. Provide light and ventilation by one of the following means:

1. Window or windows located in exterior walls facing a street, alley, yard or outer court, with:

a. Glass area not less than 10 percent of floor area; minimum three sq. ft., and

b. Ventilating area not less than 4 percent of floor area; or when acceptable to the Chief Underwriter:

2. Skylight or monitor providing natural light and ventilation equal to that required in 1 above, or

3. Artificial light and mechanical ventilation. Ventilation system shall consist of:

a. Exhaust fan, operated in parallel with light switch, with exhaust capacity of 24 cu. ft. per minute at static pressure sufficient to open multiple louvres in the ventilating grille and discharge through vent to attic or outside air. Fan shall be accessible, concealed and so installed that the noise factor in the bathroom at 5 feet above floor level will not exceed 50 decibels.

b. Louvres installed in a frame located in, and flush with upper wall or ceiling surface. Louvres shall automatically close tight when fan is not in operation. When fan is in operation louvres shall be adjusted to open sufficiently to provide air velocity through the louvred opening not exceeding 600 feet per minute.

c. An opening at bottom of bathroom door of at least ½-inch clear of floor or threshold, or a louvre in lower portion of door or wall.

d. Ventilating duct of corrosion resistant metal, 3-inch round or equivalent.

4. If a compartment containing any one fixture opens directly into the bathroom, it shall be considered a part of the bathroom floor area and may be lighted artificially and ventilated into the bathroom.

301–F. *Deleted.*

301–G. Basements. Provide light and ventilation by windows or doors in exterior wall with both glazed and ventilating area not less than 2 percent of the floor area. See 301–B–5.

301–H. Laundries and Recreation Rooms. Provide light and ventilation by windows or glazed doors in exterior walls:

1. When located in a separately enclosed space in the basement, glazed and ventilating area not less than 4 percent of floor area. See 301–G.

301 – H. Laundries and Recreation Rooms. *Continued.*

2. When located above basement level, glazed area not less than 10 percent of floor area and ventilating area not less than 4 percent of floor area.

301–I. Utility Rooms. (If heater is included, see 301–J.) Ventilate utility rooms by windows, doors or louvred openings in exterior walls having net ventilating area not less than 2 percent of floor area.

301–J. Heater Rooms. When sufficient air for proper combustion of fuel in the heating equipment cannot be expected to be supplied by infiltration directly or indirectly from outside the dwelling, provide fixed ventilation by means of a duct arranged to supply air from outside or from a permanently ventilated under-floor or attic space. Duct shall be screened, shall have a free area at least equal to the free area of flues or vents to which the fuel burning equipment is connected, and shall discharge not more than 12 inches above the floor.

301–K. Basementless Spaces. See 403–B.

1. No foundation wall vents are required for ventilating a basementless space one side of which, exclusive of structural supports, is open to a ventilated basement, provided the total area of ventilating openings in the exterior walls of the basement is at least $\frac{1}{50}$ of the combined area of the basement and basementless space.

2. When the floor construction above a basementless space is of wood or metal, and the space is not open to a ventilated basement as described above, provide:

a. At least four foundation wall vents located near the corners of the basementless space, having an aggregate free ventilating area equal to $\frac{1}{160}$ of the ground area of the basementless space in square feet, or

b. Ground surface treatment in the form of a layer of smooth asphalt roofing weighing at least 55 pounds per 108 square feet lapped a minimum of 2 inches plus at least two foundation wall vents, located for effective cross ventilation, having an aggregate free ventilating area of not less than 10 percent of that required in 2a.

3. In each vent opening install corrosion-resistant screening, 4 to 8 mesh per inch.

301–L. Attics or Spaces Between Roof and Top Floor Ceiling.

1. Provide effective cross ventilation for all spaces between roof and top floor ceiling by screened louvers or other acceptable means shown in com-

plete detail. Net ventilating area for each separate space shall be not less than:

a. For roofs with slope 3½ in 12 or greater:

(1) $\frac{1}{300}$ of the horizontal projection of the roof area over each space if,

(*a*) At least ½ of the required ventilating area is in the upper part of the ventilated space as near the high point of roof as practicable, or

(*b*) A completely continuous vapor-barrier is provided as described in 402–B–5 and 6.

(2) $\frac{1}{150}$ of the horizontal projection of the roof area over each space if not in compliance with (1) (*a*) or (1) (*b*).

b. For roofs with slope less than 3½ in 12:

(1) $\frac{1}{300}$ of the horizontal projection of the roof area if a completely continuous vapor-barrier is provided as described in 402–B–5 and 6.

(2) $\frac{1}{150}$ of the horizontal projection of the roof area if vapor-barrier is not provided.

NOTE A.—*If attic space is accessible and suitable for future habitable or walled-off storage space, at least ½ of the required net ventilating area shall be placed in the upper part of the ventilated space as near the high point of the roof as practicable and above the probable level of any future ceiling.*

NOTE B.—*If framing or other provision is made for installation of attic fan, the total net ventilating area shall be not less than $\frac{1}{100}$ of the horizontal projection of the roof area, or the net area as recommended by the Propeller Fan Manufacturers Association's publication "Residential Ventilation Guide."*

2. All ventilating openings shall be covered with corrosion-resistant screening, 8 mesh per inch.

SPACE REQUIREMENTS

302–A. Objective. *The objective of space requirements is to assure (a) that each living unit provides complete living facilities ordinarily considered necessary to a permanent home, arranged and equipped to provide suitable and desirable living, sleeping, cooking and dining accommodations, and adequate storage and sanitary facilities; and (b) rooms of such size and so planned as to permit the proper placing of adequate furniture and equipment, appropriate to and essential for the use of the occupants.*

302–B. General.

1. Each living unit shall contain not less than one bathroom and three habitable rooms, at least one of which shall be a bedroom.
2. Measurements are based upon distances between finish floor surface and rough ceiling surface (bottom of joists) and between rough wall or rough partition surfaces.

302 – B. General. *Continued.*

3. The area occupied by a stair shall not be considered a part of any habitable room.

4. Under sloping ceilings, the area with less than 5 feet clear headroom shall not be included in determining the required floor area.

302–C. Minimum Size of Spaces. Provide not less than the areas indicated for each of the following:

1. *Living-dining-cooking-sleeping.*

a. Living room, dining room, and kitchen (separate rooms):

	Minimum area square feet						
Living unit of:	*L. R.*	*D. R.*	*K.*	*Br.*	*Br.*	*Br.*	*Br.*
1 bedroom	150	70	50	100	...	...	..
2 bedrooms	150	70	60	100	70	...	..
3 bedrooms	165	85	70	100	100	70	..
4 bedrooms	180	100	80	100	100	100	70

b. Living-dining combination and kitchen:

Living unit of:	*L. D. Comb.*	*K.*	*Br.*	*Br.*	*Br.*	*Br.*
1 bedroom	160	50	100	...	...	..
2 bedrooms	160	60	100	70	...	..
3 bedrooms	180	70	100	100	70	..
4 bedrooms	200	80	100	100	100	70

c. Living room and dining-kitchen combination:

Living unit of:	*L. R.*	*D. K. Comb.*	*Br.*	*Br.*	*Br.*	*Br.*
1 bedroom	150	90	100	...	...	..
2 bedrooms	150	90	100	70	...	..
3 bedrooms	165	110	100	100	70	..
4 bedrooms	180	130	100	100	100	70

d. Living-dining-kitchen combination:

Living unit of:	*L. D. K. Comb.*	*Br.*	*Br.*	*Br.*	*Br.*
2 bedrooms	220	100	70	...	..
3 bedrooms	250	100	100	70	..
4 bedrooms	280	100	100	100	70

NOTE.—*A room otherwise conforming to requirements for a bedroom enclosed by a movable partition, may be counted as a bedroom if the partition is constructed of durable, rigid or semirigid, opaque materials which, when closed, will provide privacy in the use of the room as a bedroom by affording protection from observation and appropriate resistance to sound and intrusion.*

2. *All other habitable rooms.* Minimum floor area 70 square feet.

3. *Bathroom.* Adequate for water closet, lavatory, and tub. Arrangement of fixtures shall provide for comfortable use of each fixture and permit at least 90 degree door swing.

4. *Closets.*

a. General.

Each bedroom closet and coat closet shall provide at least 5½ feet clear clothes hanging space above the floor. At least one-half the floor area shall be level.

b. Bedroom closets. Provide each bedroom with at least one closet having a minimum:

(1) Depth, 2 feet.

(2) Width, 3 feet.

(3) Height, 6 feet above closet floor.

(4) One shelf and rod.

c. Coat closet. When required by the Chief Underwriter, provide a coat closet readily accessible to the living room preferably near the front entrance; same size and equipment as bedroom closets.

d. Linen closet. Provide each living unit with a linen closet having at least 5 shelves, approximately 12 inches o. c., located near bedrooms:

(1) for one- and two-bedroom living units, minimum size 14 inches in depth by 18 inches in width.

(2) for three- and four-bedroom living units, minimum size 14 inches by 30 inches in width.

5. *Kitchen Storage.*

a. Linear dimensions.

(1) Each kitchen shall be provided with the following minimum accessible storage for kitchen items:

Living Unit of	*Shelving (11" to 12" deep)*	*Base Cabinets (22" to 24" deep)*	*Drawers* (Aggregate width)*
1 bedroom	18′–0″	6′–0″	4′–6″
2 bedrooms	21′–0″	7′–0″	6′–0″
3 bedrooms	24′–0″	7′–6″	6′–6″
4 bedrooms	27′–0″	8′–0″	7′–0″

*Included as part of base cabinets and not additional thereto.

(2) Linear dimensions shall be measured horizontally at mid-depth. Drawers shall be measured as having the same widths as the cabinets in which they occur. Half of the width of a sink front may be counted toward required base cabinet dimensions. If a range at least 36 inches in width, or space for such a range, is provided, 1′–3″ may be counted toward required base cabinet dimensions. Depth of shelving and base cabinets may be decreased if linear dimensions are proportionally increased to provide equivalent area.

302 – C. Minimum Size of Spaces. *Continued.*

b. Height. Shelving over 6 feet from finish floor line shall not be counted in required shelving.

c. Enclosure. Enclose all required storage space below line of counter top and at least half of that above with cabinet doors or drawers.

6. *General Storage Space.*

a. Minimum total volume for each living unit in addition to 4 and 5: 150 cubic feet plus 50 cubic feet per bedroom.

b. Height: space less than 4 feet in clear height will not be considered as providing storage space under these requirements.

c. Location: basement, conveniently accessible attic space, garage, utility room, storage room, or storage closets. A coat closet and excess space in required closets shall not be included as part of the required volume. An appropriate portion of the required general storage space, suitable and adequate for the storage of items used out-of-doors and for the operation and maintenance of the property, shall be provided at a location readily accessible to the exterior. A garage providing storage space and storage space opening to the exterior shall be equipped for locking. The required volume shall include only space which is suitable for storage purposes; it shall exclude space occupied by permanent equipment and space necessary for the use and maintenance of such equipment.

7. *Fuel Storage.* Facilities shall be provided for economical delivery and handling of fuel, and for adequate storage. The storage facilities shall be provided within the dwelling or buried under ground or provision shall be made for concealment satisfactory to the Chief Underwriter.

8. *Space for Heating.*

a. Provide space within the dwelling for heating unit or system except in specific areas under the jurisdiction of the Miami Insuring Office when acceptable to the Chief Underwriter.

b. Provide clearances for maintenance and repair.

c. Provide clearances for safety, determined by insulation of heater and combustibility of walls, floor and ceiling. Heat generated shall not raise the surface temperature of combustible walls, floor or ceiling above 160° F.

9. *Space for Laundry.* Provide space for laundry facilities.

HABITABLE BASEMENT ROOMS

303–A. Objective. *The objective of requirements for habitable basement rooms is to assure that habitable basement rooms will be free of those features which create undesirable living conditions.*

303–B. Comply with requirements for main floor rooms with respect to privacy, light and ventilation, floor area, ceiling height, etc.

303–C. Finish floor below the adjoining outside finish grade: Maximum, 2′ 6″ at required windows.

ACCESS AND PRIVACY

304–A. Access.

1. *Attics.* Provide access to attics by means of scuttles, disappearing or permanently installed stairways. Minimum scuttle size, 14 x 24 inches. See 408–D–1.

2. *Basementless spaces.* Provide access openings not less than 18 x 24 inches. If sill of opening is below grade provide areaway; minimum length, 3 feet; minimum width, 2 feet 6 inches. See 308.

304–B. Privacy.

1. *Objective. The objective of privacy requirements is to assure that the location of exterior openings in relation to exterior conditions, and the interior arrangement of rooms particularly with reference to access to bathrooms from bedrooms, provide a degree of privacy commensurate with desirable living conditions.*

2. *General.*

a. Exterior openings shall be located in relation to exterior conditions, including existing or possible future adjacent buildings or other living units, so as to provide an acceptable degree of privacy.

b. The interior arrangement of rooms, particularly with respect to bedrooms, bathrooms, and toilet compartments shall be such as to provide the maximum degree of privacy.

3. *Bedroom privacy.*

a. Each bedroom shall have access to a bathroom or a compartment containing a watercloset and a lavatory, without passing through a bedroom or other habitable room. An exception to this requirement may be made for bedroom(s) in excess of two in living units of more than two bedrooms when, in the opinion of the Chief Underwriter, the specific plan under consideration will qualify as having a high degree of continuing marketability. When an exception is made, all other requirements applicable to a living unit of the number of bedrooms shown shall be observed.

b. Each habitable room shall have access to each other habitable room and to a bathroom or a compartment containing a water closet and a lavatory without passing through a bedroom.

4. *Nonacceptable bathroom arrangements.*

a. Required bathroom opening directly into a kitchen.

b. Bathroom in the basement as the only one serving a living unit located on another floor level.

CEILING HEIGHTS

305–A. Objective. *The objective of ceiling height requirements is to assure free circulation of a sufficient volume of air, and further, in rooms with sloping ceilings, to provide headroom adequate for the placing of and access to appropriate furniture in comfortable arrangement.*

305–B. Minimum Ceiling Heights.

1. *Basement.* 7 feet clear under joists. See 303–B.
2. *Main floor.* 8 feet clear.
3. *Second story.* 8 feet clear except that under sloping ceiling the minimum shall be 8 feet for at least one-half the required room area.

DOORS

306–A. Exterior Doors.

1. *Minimum sizes.*
   a. Main entrance doors: 3 feet wide.
   b. Service exterior doors: 2 feet 8 inches wide.
   c. Height: 6 feet 8 inches.
   d. Thickness: 1¾ inches.

2. Thresholds, weatherstripped, shall be provided unless omission is acceptable to the Chief Underwriter.

306–B. Interior Doors.

1. Provide a door for each opening to a bedroom, bathroom and toilet compartment. Doors to bathrooms and toilet compartments shall be of conventional type, hinged or sliding, and shall be provided with locks.

2. Minimum Sizes.
   a. All habitable rooms: 2 feet 6 inches wide.
   b. Bathrooms, toilet compartments and closets other than linen and broom closets: 2 feet wide.
   c. Height: 6 feet 6 inches.
   d. When other than conventional hinged doors are permissible, minimum clear opening shall be 2 feet 3½ inches under (a) and 1 foot 9½ inches under (b).

3. All doors shall be removable.

STAIRWAYS

307–A. Objective. *The objective of stairway requirements is to obtain stairs which provide safety of ascent and descent and which are so designed, arranged and installed as to afford adequate headroom and space for the passage of furniture.*

307–B. Design, Interior stairs. Any stair other than a disappearing stair shall comply with the following:

1. *Headroom.* See details 39 and 40. Continuous clear headroom measured vertically from front edge of tread to a line parallel with stair run:
   a. Main stairs: Minimum, 6 feet 8 inches.
   b. Basement and service stairs: Minimum, 6 feet 4 inches.

2. *Width.*
   a. Main stairs: Minimum, 2 feet 8 inches, clear of handrail.
   b. Basement, service stairs and stairs to storage attics: Minimum, 2 feet 6 inches clear of handrail, except disappearing stairs.

3. *Treads.* Minimum run, 9 inches plus 1⅛ inch nosing. Open riser basement or service stairs, minimum, 9 inches.

4. *Rise.*
   a. Maximum height, 8¼ inches.
   b. All riser heights to be same in any one stair.

5. *Winders.* Design winders so that tread width 18 inches from converging end will not be less than the tread width on the straight run.

6. *Landings.* Width not less than width of stair. A landing is required at top of any stair run having a door which swings toward the stair.

7. *Handrail.* Install continuous handrail on at least one side of each run on all stairs. The railing on an open stair complies with this requirement.

8. *Railings.* Install substantial railings around open sides of all stair wells including those in attics.

307–C. Design, Exterior Steps. Exterior steps attached to dwelling or to porch, terrace or entrance platform shall be concrete or masonry.

1. *Width,* not less than that of walk.

2. *Run:* Minimum, 11 inches.

3. *Rise:* Maximum height, 7½ inches. All riser heights shall be same in any one stair.

4. *Handrail:* Install continuous handrail on all open sides of all runs of steps to platform more than 24 inches above finish grade.

5. For other exterior steps, see 805.

AREAWAYS

308. Minimum dimension measured horizontally, at right angle to face of building wall at center line of the opening, 1 foot. Increase this dimension 1 inch for each inch of depth over 1 foot from top of area to the sill. Head of window, in all cases, shall be above top of areawall. Bottom of areaway shall be at least 6 inches below the sill of the opening and shall be effectively drained. Basement entrance and window areas in excess of 2 feet below finish grade shall be provided with adequate rail or guard.

PORCHES, TERRACES OR ENTRANCE PLATFORMS

309–A. General.

1. Provide concrete or masonry platform for all outside entrances.

2. Least dimension, 3 feet 6 inches.

309–B. Railings. When floor is over 24 inches above finish grade, install railing or guard at all edges except at steps.

GARAGES AND CARPORTS

310. When garages and carports are included, minimum sizes (inside clear dimension):

	1 Car	*2 Car*
Width	10′–0″	17′–6″
Length	19′–0″	19′–0″

311. Screens. Install screens with corrosion-resistant screening on all exterior doors and windows, mesh not less than 16 x 16 per inch. All screen doors shall be provided with an appropriate closing device.

MINIMUM CONSTRUCTION REQUIREMENTS

These Minimum Construction Requirements include all sections in the Structural Requirements, Heating Requirements, Plumbing and Sanitation Requirements, Electrical Requirements, and Lot Improvement Requirements. The provisions contained under 401–General of the Structural Requirements are also applicable to the Heating, Plumbing and Sanitation, Electrical and Lot Improvement Requirements. See also *Application,* under Foreword.

STRUCTURAL REQUIREMENTS

400. Objective. *The objective of structural requirements is to obtain a well-built and durable dwelling which provides a weather-resistant shelter. The attainment of this objective requires that (a) all portions of the structure subjected to exterior exposure be of such materials and be so constructed and protected as to prevent entrance or penetration of moisture and the weather; (b) adequate precautions be taken to properly protect materials and construction from damage by ordinary use and by decay, corrosion, termites and other destructive elements; (c) workmanship be of a quality equal to good standard practice and materials used be of such kind and quality as to assure reasonable durability and economy of maintenance, all commensurate with the class of dwelling under consideration; (d) all members and parts of the construction be properly designed to carry all loads imposed without detrimental effect on finish or covering materials; (e) each member be correctly fitted and connected; (f) the structure be adequately braced against lateral stresses; and (g) adequate precautions be taken to protect against fire and accidents.*

GENERAL

401–A. Drawings and Specifications. For required drawings and specifications, see **1** to **4.**

401–B. Application.

1. Compliance with the items listed under the various sections of the minimum construction requirements which are applicable to the property under consideration is mandatory for all proposed construction unless other requirements are imposed or specific exceptions are permitted, in accordance with provisions of this section, 401–General.
2. Existing construction including any alterations or additions thereto and any property which is under construction at the time of approval for mort-

401 – B. Application. *Continued.*

gage insurance shall comply with the stated Objectives of the Minimum Construction Requirements.

3. Since these requirements are essentially minimum, the Federal Housing Administration will recognize and give credit for all construction and equipment that exceed these requirements. The Chief Underwriter may require compliance with higher requirements than those contained herein.

401–C. Local Regulations.

1. Compliance with local regulations affecting construction, heating, plumbing, sanitation, electrical installations, and lot improvements will be required in all cases where such regulations provide for a higher standard than these requirements. The highest requirement, whether in the local regulations, these Minimum Construction Requirements, or the drawings and specifications, shall govern.

2. Compliance with local regulations which are obsolete or which for other reasons are not being enforced by local code authorities, or any local requirements which are intended merely as recommendations, is not mandatory unless the Chief Underwriter considers compliance therewith necessary to safeguard the security of the insured mortgage loan.

3. The Federal Housing Administration does not assume responsibility for determining compliance with local requirements.

401–D. Special Conditions. When special conditions exist or arise during construction, which necessitate additional precautions, the Chief Underwriter may require work in excess of these requirements.

401–E. Changes After Submission. When the applicant desires to make changes in the exhibits subsequent to the submission of an application, except for acceptable minor variations, acceptance by the FHA Insuring Office shall be requested by the mortgagee in writing prior to the execution of any changes in the construction. Request for acceptance of changes shall be accompanied by adequate information describing the proposed changes.

401–F. Materials and Equipment.

1. Materials and equipment used in the construction shall be used appropriately and shall be of a standard equal to good practice commensurate with the class of dwelling being erected.

2. When there is doubt concerning the acceptability of materials and equipment, the standards listed in Appendix C are for use as a guide in determining such acceptability. The Chief Underwriter may require tests

made by an independent commercial or university laboratory at the expense of the sponsor. The test procedure and reports shall be in compliance with applicable Federal Specifications or the specifications of the American Society for Testing Materials.

3. Newly developed materials and equipment may be used when test data and service records are submitted which indicate durability, performance and appropriate use, provided their use is acceptable to the Chief Underwriter. The data desired and procedure to be followed for determination of acceptability are described in Federal Housing Administration Technical Circular No. 4, Part II, "Special Mechanical Equipment", and Part III, "Acceptability of Uses of Individual Materials", as currently effective. Copies of this Circular may be obtained at FHA Insuring Offices.

401–G. Workmanship. Compliance with these Minimum Construction Requirements with regard to materials and methods of assembly and with drawings and specifications will not, in itself, assure acceptance of the construction. Of equal importance is good workmanship, the lack of which will be sufficient cause to refuse acceptance of the construction, or to reject the application in the case of existing construction.

401–H. Conventional Methods of Construction. Construction methods and service installations, such as heating, described in these Requirements are those in general use in conventional construction. Other conventional methods not covered in these Requirements may be used when acceptable to the Chief Underwriter. Such methods must be structurally sound, durable, safe and efficient, and at least the equivalent of those described in these Requirements.

401–I. Special Methods of Construction. New or special methods of construction, not generally considered conventional, will be treated as special cases. After complete analysis which includes structural design, marketability, etc., bulletins covering acceptable methods are issued to FHA insuring offices by Underwriting Headquarters, Washington, D. C. Data desired and procedure to be followed for determination of acceptability are described in Federal Housing Administration Technical Circular No. 4, Part I, "Shop Fabricated or Special Methods of Construction" as currently effective. Copies of this Circular may be obtained at FHA Insuring Offices.

401–J. Final Acceptance. Before final acceptance of a property as security for an insured mortgage, all buildings shall be complete and ready for occupancy with all equipment installed, connected and in operating condition and all utility connections completed, and service available.

401–K. Common Services and Facilities. Two living units included under one mortgage may have common services such as water, sewer, gas, and electricity, and common facilities such as laundry, storage and heating, except that recirculating warm air from one living unit to another is not acceptable.

INSULATION AND VAPOR BARRIERS

402–A. Insulation. When required by the Chief Underwriter, insulation shall be installed in ceilings, walls, and floors.

402–B. Vapor Barriers.

1. Many combinations of materials used in the exterior portion of wall, ceiling or roof construction have a combined vapor resistance sufficient to form a more or less effective vapor trap so that, when low outside temperatures occur, condensation is likely to form at some point within the wall, ceiling or roof construction, unless a vapor barrier of equal or greater resistance has been provided on the warm side to resist the passage of water vapor from within the dwelling.

2. When conditions described in 1 above exist, an effective vapor barrier should be installed as close as practicable to the warm (inside) surface of any exposed wall or ceiling exposed to an attic or roof.

3. The vapor resistance of the vapor barrier should be equal to or greater than the total vapor resistance of all materials and construction on the exterior side of the vapor barrier including exterior painting.

4. In conventional frame walls where sheathing paper is required and where insulation is not added within the stud spaces, a water resistant sheathing paper or felt with low vapor resistant characteristics (high vapor permeability) is preferred.

5. In all frame walls of conventional or similar construction where insulation is added within the stud spaces, the installation of a vapor barrier on the warm side of the wall shall be installed. The vapor barrier shall be as follows:

a. Paper conforming to Class A or B of Federal Specification UU–P–147, or

b. Continuous metallic sheet, or

c. Other material having moisture vapor permeability not exceeding:

(1) Six grams per 24 hours per square meter at 50 percent vs. 5 percent relative humidity and 73° F. (TAPPI test method), or

(2) One grain per square foot per hour at a vapor pressure difference through the material of one inch of mercury, or

(3) Two grains per square foot per hour at a vapor pressure difference through the material of one pound per square inch.

6. Vapor barriers shall be installed as continuous as practicable and shall be securely fastened at top, sides, bottom and at any intermediate framing. Any perforations of the barrier required for the installation of electric outlet boxes or the like shall be made so that there is a minimum of free opening.

EXCAVATION

403–A. Foundations.

1. Excavation for foundations shall extend to a level which will provide adequate bearing. In case of doubt regarding bearing capacity, tests may be required for this determination.

2. Excavation shall extend at least 1 foot below finish grade except in areas where bearing is on solid rock, minimum may be 6 inches.

3. Bottom of footing trenches shall be level. Where steps are necessary the vertical step shall not exceed the horizontal distance between steps. Horizontal distance between steps shall be not less than 2 feet. See 406–D–2.

4. Earth backfilling shall be placed carefully against foundation walls and shall be well tamped. Debris shall not be used for backfilling.

5. The earth in bottom of trenches shall be protected against freezing.

403–B. Basementless Spaces.

1. In the District covered by the Jacksonville and Tampa Insuring Offices, ground level shall be at least 20 inches below bottom of floor joists, sills, ledgers and girders. When girders frame under joists, the distance from ground level to bottom of girder may be reduced to 12 inches, provided girders are treated according to requirements of 409–E–1–a or b and continuous termite shields are placed on top of girders. When it is necessary to provide access for maintenance and repair to piping, etc., in the underfloor space, provide not less than 24 inches below bottom of joists and a means of access to all such places. In the District covered by the Miami Insuring Office, ground level shall be at least 22 inches below bottom of floor joists and girders.

2. Unless otherwise acceptable to the Chief Underwriter, interior ground level shall be not lower than outside finish grade.

3. Remove all debris, sod, tree stumps, and other organic materials and provide a smooth surface free of pockets.

ROUGH GRADING

404. See "Lot Improvement Requirements" Section 800.

MASONRY MATERIALS. *Masonry materials described herein apply to all masonry and concrete work.*

405–A. Cement.

1. Cement for concrete shall be portland cement.
2. Cement for mortar shall be portland or masonry cement. See 406–C.

405–B. Aggregate.

1. Fine aggregate for concrete: Natural sand or sand prepared from stone, gravel or blast-furnace slag.
2. Fine aggregate for mortar: Natural sand, clean and well graded.
3. Coarse aggregate for concrete: Crushed stone, gravel, blast-furnace slag or other inert materials of similar characteristics free from excessive amounts of deleterious substances.

405–C. Water. Free from injurious amounts of organic materials or other deleterious substances.

405–D. Lime.

1. Hydrated lime.
2. Quick lime shall be thoroughly slaked.

405–E. Masonry Units.

1. *General.*
   a. All units shall be of good quality, sound and free from defects.
   b. All units exposed to the weather or proposed as a stucco base shall be hard and have low water absorptive quality.
2. Brick for backup work or for interior walls shall be medium or hard burned.
3. Fire brick and flue lining shall be free of cracks or other defects.
4. Clay tile used in the construction of walls supporting floor, ceiling or roof loads shall be load-bearing tile.

5. Concrete Block aggregate shall consist of sand, gravel, crushed stone, bituminous or anthracite cinders, burned clay or shale or blast furnace slag.

CONCRETE AND MASONRY

406–A. General.

1. *Support of Masonry.* All masonry including veneer shall be supported on masonry, concrete or steel. In no case shall a wood frame be used as support of masonry.
2. *Protection.*

a. In hot weather, protect concrete and masonry work to prevent rapid drying.

b. Maintain the temperature of concrete and masonry work above freezing until thoroughly set.

3. *Loading.* Allow sufficient time for strength of concrete and masonry work to develop before subjecting to loads or traffic.
4. *Sill and Plate Anchoring.*

a. Sills for wood-frame walls and all rafter plates shall be anchored to concrete and masonry walls and piers.

b. Minimum diameter of bolts, ½-inch.

c. Embed in masonry unit walls and piers not less than 15 inches; in poured concrete, not less than 6 inches.

d. Spacing shall not exceed 8 feet o. c.; at least two bolts in each piece.

e. Install one standard nut and washer on each bolt.

f. In masonry unit walls and piers, install plate approximately 3 inches square, at head of bolt, embedded in masonry joint.

g. In specific areas subject to severe weather conditions, additional safeguards in the structural design may be required when determined necessary by the Chief Underwriter.

406–B. Concrete Work.

1. *General.*

a. Materials. See 405.

b. Water content for all plain concrete exposed to the action of freezing weather shall not exceed 6 gallons of water per bag of cement; where not exposed, 7 gallons per bag of cement. Water content for all reinforced concrete, exposed to weather or for watertight construction, shall not exceed 6 gallons of water per bag of cement. Water content specified shall include free moisture contained in the aggregate.

c. Retempering of concrete will not be permitted.

d. Reinforced concrete work shall comply with the recommendations of the Building Code Requirements for Reinforced Concrete of the American Concrete Institute.

2. *Concrete Mixes.*

a. Proportions of fine and coarse aggregate and of the total aggregate to cement shall be such as to produce a mixture which will work readily into the corners and angles of the forms and around the reinforcement with the methods of placing employed on the work, but without permitting the materials to segregate or excess free water to collect on the surface.

b. Approximate mixes for plain concrete based on damp aggregates and *making allowance for free moisture in the aggregates shall be* as follows:

		Mix		
Maximum size of aggregate	*Gallons per bag of cement*	*Cement, bag*	*Sand, cubic feet*	*Coarse aggregate, cubic feet*
¾-inch	6	1	2½	2¾
1 inch	6	1	2¼	3
1½ inches	6	1	2¼	3½

These proportions are only approximate and shall be varied as necessary to produce workable mixtures, but in no case shall the water content exceed that specified in 1–b. A minimum of 4½ bags of cement per cubic yard of concrete in place will be required in all cases.

c. Mixes for reinforced concrete shall be established as required in the Building Code Requirements for Reinforced Concrete of the American Concrete Institute.

d. Air entrained concrete may be used. Unless plant or transit mix concrete is available, concrete shall be obtained by the use of air entraining cement.

3. *Reinforcing* shall be new billet steel bars, rail steel bars, welded wire fabric or cold drawn wire.

4. *Forms.*

a. Double forms shall be used for all concrete foundation walls, except where in the opinion of the Chief Underwriter, exterior waterproofing of walls is unnecessary, bearing capacity of the soil is adequate to support the loads imposed without footings, and soil conditions permit sharp cut and stable earth banks.

b. Side forms shall be used for footings where soil conditions prevent sharp-cut trenches.

c. Build forms tight, straight, plumb and brace rigidly.

d. Do not remove forms until concrete has thoroughly set.

e. Remove all forms, spreaders and stakes before backfilling.

5. *Placing Concrete.*

a. Pour concrete continuously whenever possible and keep practically level throughout the length being poured.

b. When concrete is not poured continuously, clean, score, and wet the top surface before continuing. Key all vertical joints.

c. Spade and rod concrete thoroughly in forms.

6. *Curing Concrete.* Concrete shall be kept moist for at least 5 days after pouring.

406–C. Masonry Work.

1. *Mortar.* Mix shall be as follows for the uses indicated.

a. Portland cement mortar: one part portland cement, three parts sand by volume and lime not exceeding 25 percent of the cement by volume.

b. Cement-lime mortar: one part portland cement, one part lime and not more than six parts sand by volume.

c. Masonry cement mortar: one part Type II masonry cement and not more than three parts sand by volume. No other material except water shall be added to this mixture. Each bag of masonry cement shall bear the printed statement: "This cement complies with Federal Specification SS–C–181b, Type II Masonry Cement."

d. Masons hydrated lime mortar: one part portland cement, two parts masons hydrated lime Type S and not more than nine parts sand by volume. Each bag of masons hydrated lime shall bear the printed statement comparable to: "This lime complies with A. S. T. M C207, Hydrated Lime for Masonry Purposes, Type S."

2. *Mortar Uses.*

a. Mortar for masonry below grade:

(1) For walls 12 inches or more in thickness constructed of solid units, use mix 1–a, b, or c.

(2) For walls less than 12 inches in thickness constructed of solid units, and walls 12 inches or less constructed of hollow units, use mix 1–a unless walls are dampproofed in accordance with 406–G. If dampproofed, mix 1–b or c may be used.

(3) For walls of any thickness constructed of hollow units and not dampproofed, use mix 1–a.

b. Mortar for masonry above grade: For all walls, use mix 1–a, b, or c; mix 1–d may be used under conditions of 2–c following.

c. Mortar mix 1–d may be used in masonry construction except for masonry walls below grade, nominal 10-inch cavity walls, and load bearing walls constructed with hollow masonry units which support more than two floors and roofs or when compression on the gross area of wall exceeds 55 pounds per square inch.

d. Use of retempered mortar is not acceptable.

3. *Joints.*

a. Maximum thickness: ¾-inch.

b. Solid masonry units: fill joints solid.

c. Hollow masonry units: no through mortar joints.

d. Point all joints solid, both sides of wall. Outside and exposed inside joints shall be weathered or tooled unless otherwise acceptable to the Chief Underwriter.

e. Walls faced with 4 inches of brick backed up with hollow units shall be parged on the inside face of the brick withe, or collar joint shall be filled solid, unless otherwise acceptable to the Chief Underwriter.

4. *Bonding.*

a. Brick masonry shall be bonded with header course in every seventh course, or one through header in every 240 square inches.

b. Rubble stone masonry shall be bonded with bond stones, evenly distributed, at least 4 inches thicker than other stones; minimum 20 percent of wall area. Vertical joints shall be staggered.

c. Intersecting concrete or masonry walls shall be bonded or anchored together.

d. Closed cell units or solid masonry shall be used at rough openings, corners and wall intersections. Filling exposed ends of cells is not acceptable.

e. Bonding of backing. See 406–I–4.

5. *Cavity Wall Construction.* Cavity wall construction shall conform to requirements contained in Engineering Bulletin No. SE–65 entitled, "Exterior Masonry Cavity Wall Construction" as currently effective. Copies of this bulletin may be obtained at FHA Insuring Offices.

406–D. Footings.

1. *General.*

a. Design footings for proper distribution of superimposed loads.

b. Material shall be poured concrete.

c. Thickness of footings shall be determined in accordance with sound engineering practice and subject to the acceptance of the Chief Underwriter; in no case less than 6 inches thick.

d. Footing projection on each side of foundation wall, pier, post, column or chimney shall be determined in accordance with sound engineering practice and subject to the acceptance of the Chief Underwriter; in no case shall the projection be in excess of one-half the footing thickness unless reinforced.

e. If excavation is made too deep, fill with concrete.

f. Reinforce with steel bars where footings cross pipe trenches or similar unstable area.

g. In freezing weather, protect footings until thoroughly set. Pour footings immediately after excavation of trenches.

2. *Stepped Footings.* Where variations in the elevations of the bottom of wall footings are necessary, as may occur in the case of hillside properties, the vertical connection between footings at the step shall be constructed of concrete at least 4 inches thick and the same width as the footing. The steps shall be poured continuous with the footings. See 403–A–3.

3. *Footing Drain Tile.*

a. May be required by Chief Underwriter when water and soil conditions warrant.

b. Protect top of joints with strips of building paper or other material acceptable to the Chief Underwriter and cover with 1 foot of gravel or other material acceptable to the Chief Underwriter.

c. Connect with tight-joint pipe or tile to sewer, dry well or other outlet.

d. Drain tile shall be clay, concrete or bituminized fiber.

406–E. Concrete Slabs on Ground.

1. *Construction.*

a. Bed under slabs shall be sand, gravel, cinders, or crushed rock (unless otherwise noted below), minimum thickness 4 inches. Earth under slab bed shall be leveled and tamped.

b. Wire mesh reinforcing, when required, minimum weight 20 pounds per 100 square feet.

c. Where unusual site conditions exist slabs shall be specially designed in manner acceptable to the Chief Underwriter.

2. *Cement Floor Finish.*

a. Surface shall be troweled to a smooth finish;

b. Concrete slab shall have integral finish, or

c. Topping: minimum mix, one part portland cement, three parts sand; minimum thickness, 1 inch.

3. *Slabs on ground* used as a finish floor or as a base for other floor finish in habitable rooms:

a. Minimum thickness, 4 inches.

b. When concrete slab on ground is used as finish floor or the base for other finish flooring in habitable rooms the construction of the floor and base shall be such that water or dampness will not penetrate the slab. Normal construction precautions against water or dampness will require one or a combination of the following under all conditions except semiarid locations or where local experience has shown that no water problem will be encountered.

(1) Four-inch-thick bed of clean sand, gravel or crushed stone of uniform size, drained if below grade. Provision must be made to prevent cement paste or fines of concrete from filling the voids of the bed.

(2) Two-ply membrane waterproofing, mopped between layers with hot tar or hot asphalt, turned up to top of slab at edges, and when below grade, extended up enclosing walls to 6 inches above grade.

(3) Integral admixture to produce an acceptable waterproof slab.

(4) Smooth surface roll roofing, asphalt felt, reinforced waterproof paper or other acceptable material, lapped not less than 6 inches. When site conditions are such that ground or surface water within 1 foot of the bottom of the slab is likely, provisions (1) and (2) shall be

installed. When hydrostatic pressure will occur the construction and waterproofing shall be designed for the specific conditions. When it is unlikely that ground water will occur within 1 foot of the slab, (1) and either (3) or (4) shall be used. In semiarid locations or where local experience has shown that water or dampness will not reach the slab under the conditions presented, slab may be placed directly on firm undisturbed soil without waterproofing or the porous bed except when the slab is used for radiant heating, install (1) under all conditions.

c. Method to prevent passage of termites from beneath the slab shall be shown in detail and shall be acceptable to the Chief Underwriter.

d. Type and depth of fill under the slab is subject to acceptance by the Chief Underwriter.

e. *Bearing partitions and non-bearing masonry partitions.*

(1) Thicken slab under bearing partitions and nonbearing masonry partitions to form a beam not less than 8 inches thick and 16 inches wide. Reinforcing in thickened section, when required, to be not less than two ⅝-inch reinforcing bars 3 inches from bottom; or

(2) Install footing and foundation wall on undisturbed soil under partition.

4. *Basement floor slabs.*

a. Minimum thickness, 3 inches.

b. Bottom of slab shall be not lower than top of footing. Continue slab over footing projection to foundation wall. See detail 1.

c. Slope finish floor to drain.

d. Install bed under slab as required in 1-a except in semiarid locations or where local experience has shown that water or dampness will not reach the slab under the conditions presented.

5. *Garage floor slabs.*

a. Minimum thickness, 4 inches.

b. Provide slab at least 2 feet in front of garage door opening to form an apron; slope to driveway. See 7-c.

c. Install bed under slab as required in 1-a except in semiarid locations or where local experience has shown that water or dampness will not reach the slab under the conditions presented.

6. *Terrace and porch floor slabs.*

a. Minimum thickness, 4 inches.

b. Slab bed required in 1-a may be omitted if slab is reinforced.

c. Metal flashing shall be installed between slabs and all wood construction. See 412–F.

d. Intersection of walls with slabs. Porch and terrace slabs and concrete or masonry steps shall be supported at the intersection by metal anchors; piers or corbels built integrally or bonded to the foundation walls; or a supporting ledge on the foundation wall.

7. *Driveways and Walks.*

a. Minimum slab thickness, 4 inches.

b. If reinforced, bed required in 1-a may be omitted.

c. Expansion joints shall be provided at garage apron and at 30-foot intervals.

d. A trowel cut approximately halfway through the slab of walks shall be made at approximately 4-foot intervals.

406–F. Foundation Walls.

1. *General.*

a. Material, see 405.

b. Walls supporting frame construction shall extend not less than 12 inches above adjoining outside finish grade and be exposed not less than 10 inches. See details 5 and 8.

c. Walls supporting masonry veneered wood frame: extend foundation so that the wood construction is not less than 12 inches above outside finish grade. See detail 7.

d. Walls of hollow masonry units shall be capped with minimum of 4 inches of solid masonry or poured concrete. If concrete is used, reinforce with wire mesh (expanded metal lath not acceptable). Units with voids filled with mortar not acceptable. See 409–C.

e. Hollow masonry unit foundation walls supporting girders shall be capped under the girder with solid masonry or poured concrete, a minimum of 8 inches in height.

f. Area walls shall be anchored or bonded to the foundation wall.

g. Chimney foundations shall start at level of lowest adjacent foundation wall footings.

h. If special or unforeseen soil conditions warrant, the Chief Underwriter may require either reinforcement or increased wall thickness.

2. *Minimum Thickness.*

a. General. Not less than that of wall supported, except that foundation walls supporting one-story brick veneer wood frame walls may be 8 inches thick, provided wall construction does not project more than ¾-inch beyond exterior face of foundation walls and wood studs are not larger than 2 x 4's.

b. Poured Concrete Foundation Walls.

(1) 6 inches, minimum, for walls supporting wood frame structures less than two stories high without basements.

(2) 6 inches, minimum, for walls supporting wood frame structures less than two stories high with basements, restricted as follows:

(*a*) Mix: See 406–B.

(*b*) Double forming shall be used in all cases.

(*c*) Concrete shall be poured continuous without interruption.

(*d*) Maximum depth below grade, 6 feet unless full height wall thickness is increased 1 inch for each additional foot or fraction thereof of depth over 6 feet.

(3) 8 inches, minimum, for all other poured concrete walls.

c. Masonry Unit Foundation Walls.

(1) Masonry unit walls when not more than 7 feet below grade and when total height of foundation wall and wall supported does not exceed 30 feet at eaves and 35 feet at ridge in gable ends; minimum thickness, 8 inches. When exceeding these conditions: 12 inches, minimum.

(2) Flat-bed, square edge stone walls: 12 inches, minimum.

(3) Rubble stone walls: 16 inches, minimum.

3. *Pilasters.*

a. Concrete Walls. Pilasters shall be provided where girders frame into 6-inch poured concrete walls; minimum size of pilaster, 2 x 12 inches poured integrally with wall.

b. Masonry Walls. Pilasters shall be provided where girders, whose clear span exceeds 12 feet, frame into 8-inch masonry walls of dwellings two or more stories in height; minimum size, 4 x 12 inches built integrally with wall.

4. *Girder pockets.* Provide 4-inch end bearing for girder. Provide ½-inch air space between pocket and sides and end of wood girder.

406–G. Dampproofing and Waterproofing.

1. Basements shall be so designed and constructed as to be adequately protected at all points against penetration of moisture. Walls and floors shall be made watertight before final acceptance.

406 – G. Dampproofing and Waterproofing. *Continued.*

2. Basement and cellar walls shall be dampproofed as follows on exterior from finish grade to outside edge of footing, forming a cove at the intersection of wall with footing:

a. Masonry unit walls: apply ½-inch thick portland cement plaster coat over which apply at least one heavy coat of undiluted hot tar, hot asphalt or compound acceptable to Chief Underwriter. See detail 1.

b. Poured concrete walls: apply at least one heavy coat of undiluted hot tar, hot asphalt, or compound acceptable to Chief Underwriter.

c. If masonry veneer extends down to grade, the waterproofing described in a or b shall extend beneath and behind the veneer to the top of the foundation wall.

NOTE.—*In certain site locations, where water conditions are known to offer no problem, the Chief Underwriter may permit the omission of dampproofing.*

3. Other methods of dampproofing and waterproofing may be used subject to the acceptance of the Chief Underwriter.

4. Footing drain tile shall be installed where required. See 406–D–3.

5. For damproofing walls above grade, see 417–A–6.

406–H. Piers.

1. *Piers supporting exterior frame walls.*

a. Free standing piers may be used for one-story frame dwellings only.

b. Curtain walls, 3¾-inches minimum thickness, between piers and supported on concrete footings poured integrally with pier footings may be used for wood frame and masonry veneered wood frame construction one or more stories in height.

2. *Materials* shall be masonry or poured concrete except as noted in H–8.

3. *Minimum pier sizes.*

a. Masonry: 8 x 16 inches or 12 x 12 inches.

b. Poured concrete: 10 x 10 inches or 12-inch round.

4. *Maximum pier spacing.*

a. Exterior wall piers supporting floor joists: 8 feet o. c.

b. Exterior wall piers in line parallel to joists and interior piers: 12 feet o. c.

5. *Exterior wall piers.* Maximum height above grade four times least dimension, except when supported laterally by masonry or concrete curtain walls.

6. *Minimum pier height above grade.* 12 inches.

7. *Cap hollow masonry units* with at least 6 inches solid masonry or concrete.

406–I. Exterior Masonry Walls.

1. *Materials:* masonry or poured concrete.

2. *Minimum thickness:* 8 inches.

3. *Maximum height for 8-inch thickness,* 30 feet from footing to eaves; or 35 feet from footing to ridge in gable ends.

4. *Backing,* when used, shall be solid or hollow masonry units, and shall have minimum thickness of:

a. Four inches, when bonded to facing material as provided in 406–C–4.

b. Four inches when bonded with 3/16-inch diameter steel rods coated with a noncorroding metal or other acceptable protective coating, spaced not over 24 inches o. c. horizontally and not over 16 inches o. c. vertically, or at least one tie shall be used for each 3 square feet of wall surface. Where hollow masonry units are laid with cells vertical, rectangular ties 6 inches long, approximately 2 inches wide with ends lapped shall be used. In other walls, **Z**-shaped ties, 6 inches long with 2-inch ends bent to 90-degree angle may be used.

c. Eight inches, when tied to facing materials with corrugated metal ties.

5. *Furring* of not less than 1-inch thick pressure-treated wood strips shall be installed on exterior masonry walls less than 12 inches thick unless otherwise acceptable to the Chief Underwriter. Spacing as permitted for interior finish, see 414. Bituminous waterproofing material applied directly to masonry is not acceptable for plaster base.

6. *Lintels* supporting masonry over openings shall be steel or reinforced concrete; or masonry arches shall be installed. Lintels shall have minimum of 4 inches bearing upon solid masonry or concrete at least 4 inches thick.

7. *Girders and beams* shall have minimum of 4 inches bearing on solid masonry or concrete at least 6 inches in height and of sufficient area to distribute the load.

8. *Floor joists* shall have bearing on solid masonry not less than 4 inches thick.

9. *Chases and Recesses.*

a. Construct at time wall is built.

b. Back and sides of chases and recesses in exterior walls shall be waterproofed.

c. Recesses:

(1) Maximum depth: 4 inches.

(2) Maximum width, 30 inches; height 24 inches. When recesses occur under windows recess may be full width of window and height may extend to window sill.

406 – I. Exterior Masonry Walls. *Continued.*

(3) Provide steel or reinforced concrete lintel to support masonry directly over recesses which exceed 1 foot in width.

d. Pipe Chases:

(1) Maximum depth, 4 inches.

(2) Maximum width, 12 inches for chases 4 feet or less in length.

(3) Maximum width, 4 inches for chases over 4 feet in length.

(4) Maximum length of vertical chase in an 8-inch wall, 8 feet. Horizontal and diagonal chases are not acceptable.

10. *Tie Beams*

a. In the District covered by the Jacksonville and Tampa Insuring Offices, walls of hollow masonry units shall have an 8″ x 8″ continuous concrete (1:2:4) belt course constructed at each ceiling level, reinforced with a minimum of two ⅝-inch bars. At the top ceiling level ½-inch bolts extending at least 5 inches into the belt course shall be placed to receive the plate. Bolts shall extend through plate and shall be provided with washers and nuts. Bolts shall be spaced 6 feet o. c. maximum. Provide bolts at ends of all plate joints and at all corners, minimum 2 bolts per plate. Lintle blocks filled with concrete and constructed in manner described above may be used if acceptable to the Chief Underwriter.

b. In the District covered by the Miami Insuring Office, walls of hollow masonry units shall have an 8″ x 12″ continuous concrete (1:2:4) belt course constructed at each ceiling level, reinforced with a minimum of four ⅝-inch bars. At the top ceiling level ½-inch bolts extending at least 8 inches into the tie beams shall be placed to receive the plate. Bolts shall extend through plate and shall be provided with washers and nuts. Bolts shall be spaced 4 feet o. c. maximum. Provide bolts at ends of all plate joints and at all corners, minimum 2 bolts per plate. Lintle blocks filled with concrete and constructed in manner described above may be used if acceptable to the Chief Underwriter. When determined necessary by the Chief Underwriter additional structural safeguards will be required for gable and walls.

406–J. Masonry Veneer.

1. *Minimum thickness.*

a. Brick: 3¾ inches.

b. Ashlar stone masonry: dwellings less than 2 stories high, 3 inches; 2-story dwellings, 4 inches.

c. Rubble stone masonry: uncoursed (field stone), 12 inches; mosaic or random, 12 inches; coursed, dwellings less than two stories high, 8 inches, two-story dwellings, 12 inches.

d. Lesser thicknesses may be used when acceptable to the Chief Underwriter.

2. *Masonry veneered wood frame construction.* See details 6 and 7.

a. Veneer applied over sheathing with air space between:

(1) Air space: provide 1-inch air space between masonry veneer and sheathing.

(2) Base flashing. Material shall be one of those listed under 412–A or B or asphalt saturated felt weighing approximately 30 pounds per 100 square feet. Extend over top of foundation wall from outside face of wall and not less than 12 inches up on sheathing if sheathing paper is used. If sheathing paper is omitted (see 408–I), base flashing shall extend over top of foundation wall from outside face of wall and under sheathing for a height of not less than 12 inches, or as provided in 406–G–2–c.

(3) Water-resistant building paper or asphalt saturated felt shall be applied over sheathing except as provided in 408–I.

(4) Bonding: Corrosion-resisting metal ties spaced not more than 15 inches o. c. vertically and 32 inches o. c. horizontally. When other than wood board sheathing is used, secure ties through to studs.

(5) Weepholes, approximately 4 feet o. c., shall be provided by omitting the mortar in vertical joints at bottom course of veneer.

b. Other methods may be used subject to the acceptance of the Chief Underwriter.

406–K. Interior Masonry Walls.

1. *Material.* Masonry or poured concrete. See 405.
2. *Pipe recesses.* Construct at time walls are built.
3. *Party or lot line walls.*

a. Minimum thickness: poured concrete, 6 inches; masonry units, 8 inches.

b. Height above flat roofs, 8 inches. Cap with stone, corrosion-resisting sheet metal, portland cement mortar, or terra cotta coping.

c. Under pitched roofs: build masonry solid to underside of roof sheathing or to within 2 inches of sheathing and fill space with incombustible insulating material.

d. Not less than 4 inches of masonry shall separate all wood framing members framing into the wall.

4. *Bearing partitions.*

a. Minimum thickness: poured concrete, 6 inches; masonry units, when supporting not more than one floor and ceiling joists which carry no load, 6 inches; otherwise, 8 inches.

b. Sections of walls 2 feet or less in length, such as occur at openings, shall be constructed of solid masonry units or hollow units filled with concrete.

c. Lintels shall be steel, reinforced concrete, stone or masonry arches. Minimum 4-inch bearing shall be provided by solid masonry at least 4 inches thick.

406 – K. Interior Masonry Walls. *Continued.*

d. Joists shall bear on solid masonry at least 4 inches thick.

e. Girders shall bear on solid masonry or concrete at least 6 inches thick.

5. *Nonbearing partitions.*

a. Minimum thickness, 3 inches.

b. Lintels shall be steel, reinforced concrete, masonry arches, or reinforced structural clay tile.

406–L. Masonry Chimneys. See details 48, 49, 50 and 51.

1. *Masonry chimneys* shall be constructed gas-tight and shall bear on masonry or concrete foundations.

2. *Material,* solid masonry; footing shall be poured concrete; flue lining shall be fire clay or other material acceptable to the Chief Underwriter.

3. *Effective flue area for fireplace:* not less than 1/10 of fire place opening.

Separate flues required for each fireplace.

4. *Size and height of chimneys,* see 503.

5. *Flue Linings.*

a. Fire clay flue lining supported on masonry or concrete shall be installed in all chimneys from a point below the breeching to top of chimney.

b. Two flues may be grouped without withes provided joints of linings are staggered.

c. Withes separating flues or groups of flues, 3¾ inches thick.

6. *Chimney cap* shall be provided to form wash from flue to outside edge of chimney, minimum thickness at outside edge, 2 inches.

7. *Thimbles are required.* Thimbles and clean-out doors shall be built in at the time chimney is constructed.

8. *Clean-out doors* are required when solid fuels are used.

406–M. Fireplaces. See details 49, 50 and 51.

1. *Smoke chamber and damper* shall be installed in all fireplaces.

2. *Ash dump,* when provided, shall empty into concrete or masonry chamber provided with metal clean-out door.

3. *Lining* shall be fire brick or other material acceptable to Chief Underwriter.

4. *Hearth.*

a. Support on masonry or concrete.

b. Projection from chimney breast, at least 16 inches.

c. Width: at least 16 inches wider than fireplace opening.

STRUCTURAL STEEL AND IRON

407–A. General. Design, fabrication, and erection of structural steel shall comply with the recommendations of the American Institute of Steel Construction.

407–B. Beams and Girders.

1. *Connections.*

a. Design to carry superimposed loads.

b. Connections shall be riveted, bolted, or welded.

2. *Bearing* on walls shall be not less than 4 inches.

3. *Bearing plates.*

a. Design to distribute load, minimum thickness, $\frac{5}{16}$-inch.

b. Bed in portland cement mortar.

c. Plates may be omitted under wide-flange type steel beams.

407–C. Columns. See detail 11.

1. *Material.*

a. Standard shape, steel or cast iron.

b. Concrete-filled steel pipe, new material, standard weight or heavier.

c. Standard steel pipe. Used pipe is not acceptable.

2. *Bases and caps.* Steel or cast iron.

a. Caps shall be secured to columns and be riveted or bolted to steel girders; spike or lag-screw to wood girders.

b. Bases shall be anchored by bolts or embedded in concrete.

3. *Shims* shall be metal. Loose shims not acceptable.

WOOD CONSTRUCTION

408–A. Lumber.

1. *Softwood framing and board lumber* shall comply with American Lumber Standards and with grading requirements of the Association recognized in the trade as covering the species and under whose grading rules it was produced.

2. *Framing Lumber.* All species of soft wood framing lumber are accept-

408 – A. Lumber. *Continued.*

able subject to the maximum allowable spans for the particular species, grade, and use. See Appendix A. Allowable spans for species of framing lumber not listed in Appendix A may be obtained from the FHA Insuring Office. Studs shall be at least No. 2 Dimension except that a lower grade may be used if acceptable to the Chief Underwriter when recommended by the Association recognized in the trade as covering the particular species.

3. *Board lumber* for subflooring, sheathing, and similar uses.

a. No. 3 Common or better for Douglas Fir, Sitka Spruce, Southern Cypress, West Coast Hemlock, California Redwood, Cedar, Eastern Hemlock, Tamarack, and Southern Yellow Pine.

b. No. 4 Common or better for White Fir, Western Larch, Spruce (except Sitka), Ponderosa Pine, Sugar Pine, Idaho White Pine, Northern White Pine, and Norway Pine.

4. *Moisture Content.* All lumber shall be well seasoned. Lumber 2 inches thick and less shall have moisture content not to exceed 19 percent.

5. *Lumber dimensions.*

a. Nominal sizes are given in these requirements unless noted otherwise.

b. Minimum finish dimensions, in inches, shall comply with American Lumber Standards which are as follows:

Nominal	*Actual*	*Nominal*	*Actual*	*Nominal*	*Actual*
1	$^{25}/_{32}$	4	$3\frac{5}{8}$	8	$7\frac{1}{2}$
2	$1\frac{5}{8}$	5	$4\frac{5}{8}$	10	$9\frac{1}{2}$
3	$2\frac{5}{8}$	6	$5\frac{5}{8}$	12	$11\frac{1}{2}$

408–B. Framing—General.

1. *Structural framing members.*

a. Splicing between bearing points is not acceptable.

b. When structural strength is impaired by cutting, drilling, or by inherent defects, members shall be replaced or reinforced in a manner acceptable to the Chief Underwriter.

c. Provide framing for any unusual loading conditions which require special consideration; such framing subject to the acceptance of the Chief Underwriter.

2. *Framing at chimneys and flues.* See details 48, 50 and 51.

a. Bearing of framing members on chimney masonry is not acceptable. Piers built integral with chimney may be used.

b. Framing members shall be not closer than 2 inches to chimney masonry. Fill 2-inch space with incombustible insulating material.

c. For chimneys and flues other than masonry, provide clearances according to requirements of Underwriters Laboratories Inc., "List of Inspected Gas, Oil and Miscellaneous Appliances."

3. *Firestopping.*

a. Partitions, outside stud walls and furring space of masonry walls shall be firestopped at first floor and at attic.

b. Wood blocks or masonry, tightly fitted, or other method acceptable to Chief Underwriter, may be used.

4. *Recommended nailing schedule.* Nailing of joints in framing according to the following schedule using common or smooth box nails is acceptable:

Joist to sill or girder, toe nail	2–16d
Bridging to joist, toe nail each end	2–8d
1 x 6-inch subfloor to joist, face nail	2–8d
1 x 8-inch subfloor to joist, face nail	3–8d
2-inch subfloor to joist or girder	2–16d
Sole plate to joist or blocking	16d–16" o. c.
Top plate to stud, end nail	2–16d
Stud to sole plate, toe nail	3–16d
Doubled studs	16d–30" o. c.
Top plates, spike together	16d–24" o. c.
laps and intersections	3–16d
Ceiling joists, to plate, toe nail	2–16d
laps over partitions	3–16d
to parallel alternate rafters	3–16d
Rafter to plate	3–16d
1-inch brace to each stud and plate	2–8d
1 x 6-inch sheathing, to bearing	2–8d
1 x 8-inch sheathing, to bearing	3–8d
Corner studs and angles	16d–30" o. c.
Furring strips to masonry	casehardened– 16" o. c.

Plywood:

subfloor to joists, edges	8d– 6" o. c.
subfloor to joists, intermediate	8d–10" o. c.
roof sheathing to rafters, edges	8d– 6" o. c.
roof sheathing to rafters, intermediate	8d–12" o. c.
wall sheathing to studs, edges	6d– 6" o. c.
wall sheathing to studs, intermediate	6d–12" o. c.

Other joints, nail to provide proportionate strength.

408–C. Floor Framing.

1. *Columns and posts.*

a. Structural steel or iron. See 407.

b. Wood posts in basement shall bear on concrete base resting on footing;

top of base shall be 3 inches above finish floor; securely fasten top of post to girder. If necessary for full bearing, install bearing plate or cap secured to both post and girder.

c. Posts shall be one piece and squared at both ends. Minimum size: basement, 6 x 6 inches; above basement, 4 x 4 inches; above basement and supporting wood porch floors, 4 x 4 inches. See 406–H–8.

2. *Girders.*

a. Material: structural steel, reinforced concrete, solid wood, or built-up wood.

b. The distance between supports under wood girders shall not exceed the following:

Maximum spans for wood girders

Size in inches	Maximum clear span				Size in inches	Maximum clear span			
	1-story dwellings		1½- and 2-story dwellings			1-story dwellings		1½- and 2-story dwelling	
	Ft.	*In.*	*Ft.*	*In.*		*Ft.*	*In.*	*Ft.*	*In.*
4 by 6	5	0	4	0	4 by 10	8	0	7	0
6 by 6	6	0	5	2	6 by 8	8	0	7	0
4 by 8	6	4	5	6	6 by 10	9	0	8	0

NOTES.—*The above spans are based on a fiber stress of 1,200 pounds. When the allowable fiber stress of the species of wood used is other than 1,200 pounds, spans shall not exceed those determined by established engineering practice.*

If the total of the spans of joists framing into the girder on both sides exceeds 24 feet 2 inches, or if loads are concentrated, the size and span of the girder shall be determined by established engineering practice.

c. Joints of solid and built-up wood girders shall be made over pier or column supports only. See detail 11.

d. Provide ½-inch air space at end and each side of wood girder framing into masonry.

3. *Floor Joists.*

a. Spans for wood floor joists shall not exceed those tabulated in span tables in Appendix A.

b. Maximum joist spacing is limited by the direction of the finish flooring, the type of subflooring and ceiling material on underside. For single thickness flooring, maximum joist spacing, 16 inches, o. c.

c. Framing into headers or side of wood girders. See details 13 and 15. Use steel angles 3 x 3 inches, 18 gauge, 7 inches long, applied on sides of joists, or use steel joist hangers, or wood bearing strip, at least 2 x 2 inches. Joists shall not be notched more than one-fourth of joist depth.

d. Framing into side of steel girders. See detail 12. One-half-inch clearance shall be allowed over top of top flange. Secure to girder or to opposite joists. Notch for bearing shall be not more than one-fourth of joist depth.

e. Framing into masonry. See detail 14.

(1) Minimum joist bearing, 3 inches.

(2) Ends of joists shall have 2-inch fire cut or bevel.

(3) All floor joists except first floor joists framing into masonry walls: Anchor end of each fourth joist to masonry with metal straps (T-anchors) applied near bottom of joists.

(4) All joists except first floor joists parallel with masonry shall be tied to masonry with metal straps spaced not more than 8 feet o. c. extending over and secured to at least 3 joists.

f. Framing over girders and bearing partitions. See details 16 and 18. Ends of joists shall be lapped and spiked together or butted over center of bearing. When lapped, minimum lap 4 inches; maximum lap 8 inches. When butted, tie with metal straps (⅛ x 1 x 18 inches minimum), or 1 inch thick wood ties at least 2 feet long. Nail joists to bearing or cross block between joists when bearing is other than wood.

g. Double joists.

(1) Joists shall be doubled under all partitions when parallel to floor joists unless otherwise acceptable to the Chief Underwriter. Provide additional joists or supports as required by loading conditions, subject to acceptance by the Chief Underwriter.

(2) Where piping or duct work occurs, block joists apart at 4-foot intervals.

h. Headers and trimmers.

(1) Headers receiving more than four tail beams shall be supported by two 3 x 3-inch steel angles applied one on each side of header and secured to the trimmer; by steel joist hangers; or by wood posts. Headers 4 feet or less in length may be single and shall be supported as above or by wood bearing strips or other support acceptable to the Chief Underwriter.

(2) When openings occur at end of joist span and header is 4 feet or less in length, trimmers may be single.

(3) Double framing shall be used under all other conditions.

i. Cutting of floor joists. See detail 17.

(1) Notching top or bottom of joists not more than ⅙ joist depth for piping and duct work is permitted in end third of span only; otherwise header shall be installed.

(2) Holes may be bored through joists, maximum diameter 2½ inches; edges not nearer than 2 inches to top and bottom of joists.

300439 O - 54 - 5

j. Cross-bridging.

(1) Maximum spacing, 8 feet; minimum size, 1 x 3 inches; double-nail at each end.

(2) Rigid metal bridging may be used when acceptable to Chief Underwriter.

k. Cantilevered construction. Detail drawings shall be submitted. See details 19 and 20.

l. Where wood floor joists rest directly on masonry foundations, a continuous boxing joist of the same size as the joists shall be provided.

4. *Subflooring.*

a. Wood boards, as a base for wood finish flooring. See 415–B.

(1) Boards shall be square edge or T and G with ends cut parallel to and over center of joists; or T and G end-matched boards shall be used with no two end joints in adjoining boards occurring within the same joist space and with each board bearing on at least two joists.

(2) Minimum thickness, $^{25}/_{32}$-inch; maximum width, 8 inches.

(3) Maximum joist spacing: 16 inches o. c. when finish strip flooring is parallel to joists, or when parquet finish flooring is used; 24 inches o. c. when finish strip flooring at least $^{25}/_{32}$-inch thick is at right angles to joists.

(4) Nail at each bearing. Boards less than 8 inches in width shall be double-nailed; 8-inch boards shall be triple-nailed.

(5) Install blocking between ends of joists at wall for nailing ends of diagonal subfloor boards.

b. Wood boards as a base for linoleum, composition, or rubber tile.

(1) Boards shall be T and G; minimum thickness, $^{25}/_{32}$-inch; maximum width, 3¼ inches. See 4–a–(1).

(2) Maximum joist spacing 16 inches o. c.

(3) Nail at each bearing. See 4–a–(5).

(4) Sand and scrape smooth.

c. Wood boards as a base for ceramic tile. See 415–C and details 36 and 37.

(1) Boards shall be square edge or T and G. See 4–a–(1).

(2) Minimum thickness, $^{25}/_{32}$-inch; maximum width, 8 inches.

(3) Maximum joist spacing, 16 inches o. c.

(4) Nail at each bearing. Boards less than 8 inches in width shall be double-nailed; 8-inch boards shall be triple-nailed. See 4–a–(5).

d. Plywood.

(1) When used as a base for wood finish floors, linoleum, composition, rubber or ceramic tile:

Minimum thickness subfloor (5-ply)	*Minimum thickness finish flooring*	*Maximum joist spacing (inches)*
½-inch*...	$^{25}/_{32}$-inch, wood strip if laid at right angles to joists.....	24
½-inch*...	$^{25}/_{32}$-inch, wood strip if laid parallel to joists.....	20
½-inch....	$^{25}/_{32}$-inch, wood strip if laid at right angles to joists.....	20
½-inch*...	Less than $^{25}/_{32}$-inch, wood or other finish.....	†16
⅝-inch*...	Less than $^{25}/_{32}$-inch, wood or other finish.....	†20
¾-inch*...	Less than $^{25}/_{32}$-inch, wood or other finish.....	†24

* Installed with outer plies of subflooring at right angles to joists.
† Wood strip flooring, $^{25}/_{32}$-inch thick or less, may be applied in either direction. See 415–B.

(2) When used as base for parquet wood finish flooring less than $^{25}/_{32}$-inch thick, linoleum, composition, rubber or ceramic tile: install solid blocking under all edges at right angles to floor joists.

(3) When used for leveling purposes over other subflooring, minimum thickness, ¼-inch, 3 ply.

e. Clearance: provide ½-inch clearance between all subflooring and all masonry walls and partitions.

408–D. Ceiling Framing.

1. *Joists.*

a. Ceiling joist spans shall not exceed those tabulated in tables, Appendix A.

(1) When access opening to attic does not exceed 400 square inches, use table entitled "No Attic Storage"; minimum scuttle size, 14 x 24 inches.

(2) When access opening exceeds 400 square inches, use table entitled "Limited Attic Storage"; minimum opening size, 24 x 36 inches.

(3) When a permanent or disappearing stair is provided, use table entitled "Floor Joists." Framing to comply with 408–C.

b. Use ceiling joists as ties for rafters not more than 4 feet o. c.

c. Framing of ceiling joists over girders and bearing partitions as required for floor joists. See 408–C–3–f.

2. *Hung ceilings,* flat roof construction.

a. Ceiling joists parallel to roof joists: size, 2 x 4's same spacing as roof joists; hangers, 1 x 4's spaced not more than allowable span for ceiling joists with "No Attic Storage." See detail 34.

b. Ceiling joists at right angles to roof joists: size, 2 x 4's spaced not more than 24 inches o. c.; hangers 2 x 2's spaced not more than allowable span for ceiling joists with "No Attic Storage," with not more than three hangers on any one roof joist. See detail 35.

408–E. Roof Framing.

1. *General.*

a. Headers and trimmers.

(1) Headers 4 feet or less in length may be single.

(2) When chimney is at ridge or eaves and header is 4 feet or less, trimmers may be single; double framing shall be installed under all other conditions.

(3) Double headers and rafters shall be installed at dormer windows which are not supported on partitions.

b. Wall plates for rafters and roof joists shall have solid bearing and shall be anchored to masonry walls. Rafters and flat roof joists shall be anchored by the following means:

(1) Rafter or joist anchors into concrete tie beam at alternate rafters or joists when spacing is 16 inches o. c. When spacing is over 16 inches o. c., anchors shall be provided for each rafter or joist. For flat roofs, anchors shall also be provided to bearing partition top plates.

(2) Hurricane clips at alternate rafters or joists when spacing is 16 inches o. c. and at each rafter or joist when spacing is more than 16 inches o. c.

2. *Pitched roofs.*

a. Minimum slope. See 411.

b. Rafter spans shall not exceed those tabulated in tables, Appendix A.

c. Rafters shall be cut for level bearing and spiked to wall plate; frame rafters opposite one another at ridge; provide tie for rafters to prevent thrust.

d. Collar beams. See detail 32.

(1) Minimum size, 1 x 6 inch or 2 x 4 inch; maximum spacing, 5 feet o. c.

(2) When collar beams are above the lower third of the rafters, and ties are not provided at the plate line, provision shall be made for tying the

lower end of rafters to floor, ceiling or wall construction. If the collar beams serve as ceiling joists in such cases, they shall be of same thickness and spacing as rafters.

e. Ridge Boards. Depth of ridge boards shall be not less than cut end of rafter. See detail 32.

f. Hip and valley rafters.

(1) Minimum thickness, 2 inches; minimum depth, not less than cut end of jack rafters. Design to carry the loads imposed.

(2) When jack rafters of one roof frame on sole plate on top of roof sheathing applied to full length rafters of adjoining roof, valley rafters may be omitted.

g. Saddles. Crickets or chimney saddles shall be installed at upper side of all chimneys not in contact with ridge.

3. *Flat roofs.*

a. Roof joist spans shall not exceed those tabulated in tables, Appendix A.

b. Joists shall be cross-bridged; minimum size, 1 x 3 inches; maximum spacing, 8 feet o. c.; double-nailed at each end.

c. Anchoring of roof joists and framing over girders and bearing partitions shall be same as required for floor joists. See 408–C–3–e–(4) and 408–C–3–f.

4. *Trussed roof construction.* Design of trusses and roof construction shall be subject to acceptance of the Chief Underwriter.

408–F. Exterior Wall and Bearing Partition Framing.

1. *Studs.*

a. Studs shall be continuous lengths without splicing.

b. Minimum size, 2 x 4 inches.

c. Maximum spacing: for all two-story construction, 16 inches, o. c.; for construction less than two stories, determined by the type of interior finish when walls are sheathed and by the type of exterior or interior finish when walls are unsheathed; the lesser permissible spacing shall govern. Maximum spacing in any case, 24 inches o. c. See 410 and 414.

d. Maximum length for balloon frame, 20 feet; notch studs at second floor to receive 1 x 4 ribbon; nail joists to studs.

2. *Corner construction.*

a. Corner posts shall be not less than three 2 x 4's set to receive interior finish. See details 25, 26 and 27.

b. Corners of rooms shall be framed to receive interior finish. See details 23 and 24.

3. *Corner bracing.* See details 21 and 22.

a. Braces shall be installed at all external corners except as provided for in d. Use 1 x 4's let into outside face of studs, corner post, sill and plate, set at 45° extending from bottom of sill to top of plate. Use two–8d nails at each bearing.

b. Openings near corner: use knee braces extending from corner post to sill and to top plate; extend over at least 3 stud spaces.

c. Openings at corner: brace as in 3–a, set as near opening as possible.

d. Corner braces may be omitted only when:

(1) Wood sheathing boards are applied diagonally, or when

(2) Plywood sheathing (4 x 8-foot sheets) is nailed with 6d nails, 6 inches o. c. on all edges and 1 foot o. c. at intermediate bearings (see 408–H–2), or when

(3) Test data are submitted which indicate sheathing material otherwise acceptable will meet requirements for resistance to racking acceptable to the Chief Underwriter.

4. *Sill construction.* See details 6 through 10.

a. Sills shall be anchored.
See 406–A–4.

b. Sills and girders on top of foundation walls and piers shall be leveled and grouted with portland cement mortar; wood is not acceptable as permanent shims.

c. Other methods may be used if detailed on drawings submitted with applications and acceptable to the Chief Underwriter.

5. *Window and door openings.*

a. Inner stud on jambs shall extend in one piece from header to bearing and shall be nailed to outer stud. See details 21 and 22.

b. Headers for usual loading conditions:

Size	*Maximum span*	
Two 2 x 4's on edge	3′–6″	
Two 2 x 6's on edge	4′–6″	
Two 2 x 8's on edge	6′–0″	Truss construction preferred.
Two 2 x 10's on edge	7′–6″	See detail 28.
Two 2 x 12's on edge	9′–0″	

NOTE.—*Headers for special conditions may vary from above provided substantiating engineering data are submitted for acceptance by the Chief Underwriter.*

c. Where headers support concentrated loads or are subjected to other unusual loading conditions, the header shall be specially designed.

d. Install suitable grounds to secure full ½-inch plaster thickness.

6. *Plates.*

a. Top plates shall be two 2 x 4's. Plate members shall be lapped at corners and intersecting partitions; when plates are cut for piping or duct work, install steel angle tie for plate and bearing for joists. See detail 33.

b. Sole plates shall be 2 inches minimum thickness; exterior wall studs may bear on the sill or on a sole plate on top of subfloor. Install continuous strip of 30-pound asphalt saturated felt under sole plate for wood frame partitions over concrete slab on ground floors; width of strip not less than width of partition.

7. End studs of bearing partitions connecting to masonry walls shall be anchored with bolts approximately 2 feet 6 inches o. c.

8. Wood-bearing partitions in cellars and basements are not acceptable.

408–G. Nonbearing Partition Framing.

1. *Studs.*

a. Studs shall be continuous lengths without splicing.

b. Maximum spacing:

(1) Partitions less than 6 feet unsupported length:

Size	*With openings*	*Without openings*
2 x 4's (2″ thickness)	16″ o. c.	16″ o. c.
2 x 3's (3″ thickness)	16″ o. c.	24″ o. c.[1]
2 x 4's (4″ thickness)	24″ o. c.	24″ o. c.[1]

(2) Partitions over 6 feet unsupported length:

Size	*With openings*	*Without openings*
2 x 4's (2″ thickness)	.....	16″ o. c.
2 x 3's (3″ thickness)	16″ o. c.	24″ o. c.[1]
2 x 4's (4″ thickness)	24″ o. c.	24″ o. c.[1]

[1] This spacing depends upon type of interior finish. See 414.

c. Corner of rooms shall be framed to receive interior finish. See details 23 and 24.

2. *Openings.* See detail 31.

a. In 2-inch thick partitions: inner stud on jambs, size 2 x 2 inches, extend in one piece from header to bearing and nail to outer stud; or single frame with 2 x 6-inch jambs continuous from top plate to sole plate with header notched 2 inches into each jamb.

b. In 3-inch and 4-inch thick partitions: single framing is permitted provided opening does not exceed 3 feet in width and header is secured by spiking through jamb studs.

c. Headers:

(1) Opening width, 3 feet or less:
2-inch thick partitions, one 2 x 3 on edge.
3-inch thick partition, one 2 x 3 flat.
4-inch thick partition, one 2 x 4 flat.

(2) Opening width, over 3 feet:
2-inch thick partition, one 2 x 3 on edge.
3-inch thick partition, two 2 x 3 flat.
4-inch thick partition, two 2 x 4's.

d. Install suitable grounds to secure full ½-inch plaster thickness.

3. *Top and sole plates* shall be 2 inches nominal thickness.

4. *Nailing member* secured to joists by blocking shall be provided on top of plate for securing ceiling finish when parallel to ceiling joists. See detail 29.

5. *Movable or sliding partitions.* See Note under 302–C–1–d.

408–H. Wall Sheathing.

1. *Wood Boards.*

a. Minimum thickness, 1 inch ($^{25}/_{32}$); maximum width, 8 inches; maximum stud spacing, 24 inches o. c.

b. Break joints over center of studs unless end-matched (T and G) boards are used; if end-matched, no two adjoining boards shall break joints over same stud space and each board shall bear on at least two studs.

c. Application: when applied diagonally, boards shall extend at 45 degrees in opposite directions from each corner.

d. Sheathing of wood boards applied diagonally shall be installed on all two-story frame and masonry veneer structures.

2. *Plywood.*

a.	*Minimum thickness*	*Maximum stud spacing*
	$^{5}/_{16}$-inch	16 inches
	$^{3}/_{8}$-inch	24 inches

b. Types of finish which affect the minimum thickness of plywood used:

(1) Under wood shingles: if $^{5}/_{16}$-inch plywood is used, apply shingles over 1 x 2-inch nailing strips using copper or galvanized nails for attaching shingles. Nailing strips may be omitted if barbed nails are used for attaching the shingles.

(2) Under asbestos-cement shingles and siding: if 5/16-inch thick plywood is used, apply siding or shingle material with barbed nails. Do not apply over wood nailing strips.

3. *Fiber Board.*

a.	*Minimum thickness*	*Maximum stud spacing*
	½-inch	16 inches
	¾-inch	24 inches

b. Under wood shingle siding: apply 1 x 2-inch nailing strips over sheathing, spaced according to shingle exposure. See detail 44.

c. Fiber board is not acceptable as a nailing base unless special method of attachment acceptable to Chief Underwriter is used. See 410–B and 410–C.

d. 1 x 3-inch nailing strips may be applied directly to the studs and underneath the sheathing, spaced according to shingle exposure, provided shingle material is applied with nails at least 2 inches in length.

4. *Gypsum Board.*

a. Minimum thickness, ½-inch; maximum stud spacing, 24 inches.

b. Under wood shingle siding: apply 1 x 2-inch nailing strips over sheathing, spaced according to shingle exposure. See detail 44.

c. Gypsum board is not acceptable as a nailing base unless special method of attachment acceptable to Chief Underwriter is used. See 410–B and 410–C.

d. 1 x 3-inch nailing strips may be applied directly to the studs and underneath the sheathing, spaced according to shingle exposure, provided shingle material is applied with nails at least 2 inches in length.

408–I. Sheathing Paper. See 406–J–2 and 412–B–2 and 4.

1. *Material.* See 402–B.

a. Building paper shall be water-resistant of vapor-permeable type.

b. Asphalt saturated felt, 15 lb. maximum.

2. *Application.*

a. Apply shingle fashion, 4-inch lap; lap 4 inches on strips around openings.

b. Strips of sheathing paper, at least 6 inches wide, shall be installed behind all exterior trim of exterior openings.

c. Install over stud frame when sheathing is not used and over all types of sheathing except as noted in 3 below.

408 – I. Sheathing Paper. *Continued.*

3. *Sheathing paper may be omitted* over:

a. Interior type plywood conforming to Commercial Standard CS 45 provided all edges of boards are caulked with elastic waterproof caulking material; or

b. Fiber board sheathing which has been factory treated by asphalt coating or impregnation to render it water-resistant and conforming to Commercial Standard CS 42 (Class E); or

c. Core-treated water-repellent gypsum sheathing board. Each board shall be labeled "Gypsum, Water-Repellent Sheathing Complying with Proposed ASTM Specification C 79"; or

d. Non-core treated gypsum sheathing which has been factory treated to render the board moisture resistant (water-repellent paper over gypsum). Each piece of gypsum board sheathing shall bear a printed statement that it is "Water-Repellent." All edges of board which are cut on the job shall be caulked with elastic waterproof caulking material. In lieu of caulking material at corners, strips of water-resistant building paper or asphalt saturated felt not less than 18 inches in width applied shingle fashion may be used to protect vertical joints at corners.

NOTE.—*All horizontal joints between boards of fiber or gypsum shall be tongue and groove, "V" type or flashed in manner acceptable to the Chief Underwriter.*

4. *In all cases where sheathing paper is omitted,* the bottom edge of the sheathing board at the head of openings shall be so located as to permit the head flashing to extend under the sheathing and to be turned up behind the sheathing. The joint between the sheathing board and the head flashing shall be caulked.

408–J. Roof Sheathing.

1. *Wood boards.*

a. Tongue and groove boards shall be used where exposed as finish ceiling and exposed at soffits. In the area under the jurisdiction of the Miami Insuring Office, all wood board roof sheathing shall be tongue and groove.

b. Minimum thickness, 1 inch ($^{25}/_{32}$); maximum width, 8 inches; maximum rafter spacing, 24 inches o. c.

c. Break joints over center of rafters unless end-matched (T and G) boards are used; no two adjoining boards, if end-matched, shall break joints over same rafter space and each board shall bear on at least two rafters.

d. Application. Lay closed under any roof material except that under wood shingles, 1 x 3-inch shingle lath spaced according to shingle exposure may be used instead of closed sheathing.

e. All loose knots or knot holes 1-inch or larger in diameter shall be tinned.

2. *Plywood.*

a. Roofing material.

	Rafter maximum spacing (inches)	*Plywood minimum thickness (inches)*
Wood and asphalt shingles	16	5/16
	24	3/8
Slate, tile and asbestos-cement	16	1/2
	20	1/2
	24	5/8
Flat roofs	16	3/8
	24	1/2

b. Application. Apply grain of outer plys at right angles to rafters.

c. Under wood shingles: apply 1 x 2-inch nailing strips over plywood less than 1/2-inch thick, spaced according to shingle exposure.

d. Protection. Plywood roof sheathing, unless of exterior type, shall have no surface or edge exposed to the weather.

408–K. Stairs and Steps. See 307–B.

1. *Treads* of main stairs should be hardwood.
2. *Stringers.* See details 41 and 42.

a. Provide solid bearing at top and bottom.

b. Effective depth of wood stringers: Minimum, 3 1/2 inches.

c. Open basement stairs: minimum stringer thickness, 2 inches.

d. Third stringer: install if treads are less than 1 1/8 inches thick or if stair is more than 2 feet 6 inches wide.

e. The stringers of stairs to basement shall not penetrate the concrete floor or topping. They shall bear upon the top of the floor slab or on a raised masonry or concrete base or on the bottom step constructed of concrete.

3. *Construction.* Method of stair assembly shall be acceptable to the Chief Underwriter.

408–L. Caulking.

1. Caulk around exterior openings in masonry or masonry veneer walls.
2. Caulk at intersections of wood and masonry except when flashed. This does not apply to tops of foundations.

PROTECTION AGAINST TERMITES

409–A. Methods of Protection. Provide protection by one or more of the following means in localities where, in the opinion of the Chief Underwriter, protection is necessary. For clearances between any wood construction and ground level, see 403–B and 406–F–1.

1. *Poured concrete foundations.* See 409–B.

2. *Masonry unit foundations capped with reinforced concrete.* See 409–C.

3. *Metal shields.* See 409–D and 412–F.

4. *Wood preservative treatment.* See 409–E. *This method protects only the members treated.*

409–B. Poured Concrete Foundations. Poured concrete shall be of a quality to assure foundation walls which will be free from cracks, porous areas, and voids or portions that may in time disintegrate. See 405 and 406–B.

409–C. Reinforced Concrete Caps. See detail 10.

1. *Materials.*

a. Concrete. See 409–B.

b. Reinforcing: 2 x 2-inch wire mesh, minimum wire 14-gauge; expanded metal lath not acceptable.

2. *Installation.*

a. Minimum thickness, 4 inches.

b. Pour continuous in one operation on top of all unit masonry foundation walls and piers; and under joists, sills and girders, unless shielded.

409–D. Metal Shields.

1. *Material,* minimum weight or gauge:

a. Copper, cornice temper, 12-ounce.

b. Galvanized sheet metal, 26 gauge, 1.25-ounce zinc coating (total both sides) per square foot.

c. Terneplate: IC or IX, 40-pound coating, painted both sides.

d. Copper-coated building paper, minimum coating 3-ounce, for use only where no projection is required.

e. Special types of metal shields may be used provided acceptance is first obtained from the Chief Underwriter and installation is in accordance with manufacturer's recommendations.

2. *Installation.* See details 4 through 9.

a. Continuous on top of foundation walls under wood sills, and under end of wood girders and joists, and on top of piers.

b. Lock or solder seams entire length. Spot soldering not acceptable.

c. Caulk sill bolts or other pentrations with coal-tar pitch or other material acceptable to the Chief Underwriter.

d. Bent or damaged shields shall be straightened or repaired.

e. For foundation walls in and enclosing basementless areas, including masonry or concrete walls separating basement from basementless spaces, extend shield through wall (at least 8 inches above finish grade) under wood construction.

f. Project two inches beyond inside face of foundations in basementless areas and turn down additional two inches on 45° angle. In basements, projection beyond face of wall may be reduced to ½-inch.

g. Projection outside foundations to extend down on angle to show ¼-inch below wood finish.

h. Wood posts in basements: install shield between post and base.

i. Untreated wood girders framed into masonry unit foundation walls below concrete cap: install continuous shields around and under ends of girders extending the shields 4 inches into the joint between the walls and concrete cap; shield shall extend at least to the inside face of the wall. Air space each side of girder, ½-inch.

409–E. Wood Preservative Treatment.

1. *Acceptable methods of treatment.*

a. Full- or empty-cell pressure process. *Preferred method of treatment.*

b. Hot-and-cold bath process.

NOTE.—*Brush coat, spraying, or dipping methods of treatment not acceptable when preservative treatment is mandatory.*

2. *Application.* Treat all lumber in contact with foundation walls or piers including girders, sills, floor joists, headers and firestopping.

409–F. Additional Protection.

1. Where pipes enter ground in basementless spaces, install conical metal shields caulked with coal-tar pitch. Minimum distance of pipe to wall, 4 inches; minimum distance of shield to wood construction, 4 inches.

2. All horizontal pipes in basementless spaces shall be at least 18 inches above ground.

3. Metal flashing shall be used between all woodwork and abutting masonry or concrete terraces or platforms. See 412–F.

4. In severely infested areas, the Chief Underwriter may require both shields and preservative treatment of lumber and may also impose special structural requirements.

EXTERIOR WALL FINISH

410–A. Wood Siding.

1. Acceptable siding grades shall be determined by the Chief Underwriter. Grade shall be commensurate with quality and class of dwelling. Species and grade shall be listed on FHA Form 2005 and in specifications for siding, using same term as in grading rules of producer's association.

2. Well seasoned material shall be used. Moisture content shall not exceed 12 percent.

3. *Bevel siding* (lapped or rabbeted).

a. Finish dimensions, except as in b, shall be:

Nominal width in inches	*Minimum thickness in inches:* *at top*	*at butt*
4, 6, and 8	3/16	7/16
10	3/16	9/16
12	3/16	11/16

b. When bevel siding is applied directly to studs spaced not more than 16 inches o. c., or when applied over fibre board sheathing with studs spaced 20 or 24 inches o. c., minimum finished thickness of siding shall be 3/16-inch at tip and 11/16-inch at butt. Maximum width of siding, 10 inches.

c. Minimum headlap: 1 inch for 4- and 6-inch width; 1¼ inches for widths over 6 inches.

d. Nailing. Nail at each bearing; set face nails and seal with putty after application of prime coat of paint, unless hot-dipped galvanized or aluminum nails* are used, in which case setting and puttying of nails may be omitted if acceptable to the Chief Underwriter.

*NOTE: *If aluminum nails are used, see FHA Use of Materials Bulletin on Aluminum Building Products.*

4. *Rustic and drop siding.*

a. Minimum thickness, ¾-inch (finished); maximum width, 8 inches (nominal).

b. Nailing. See 410–A–3–d.

5. *Shiplap or matched siding* (flush).

a. Minimum thickness, 25/32-inch (finished); maximum width, 12 inches (nominal).

b. Nailing. See 410–A–3–d.

c. When boards are applied vertically:

(1) Set edges in white lead or other material acceptable to the Chief Underwriter.

(2) Provide 2 x 4-inch blocking between studs, 24 inches o. c.

6. Shiplap, drop, novelty or flushback siding shall be applied directly to studs or on vertical furring strips, minimum 1 inch x 2 inch, placed on the face of sheathing. Furring strips shall occur at studs. Shiplap, drop, novelty or flushback siding applied directly to sheathing surface is not acceptable.

410–B. Wood Shingle Siding.

1. *Shingle grades.*

a. Single course siding, No. 1 or No. 2 grade.

b. Double course siding, No. 1 or No. 2 grade for exposed shingles; under course may be No. 1, No. 2 or No. 3.

2. *Maximum exposure.*

Shingle length (inches)	*Single course exposure (inches)*	*Double course exposure (inches)*	
		No. 1 grade of outer course	*No. 2 grade of outer course*
16	7½	12	10
18	8½	14	11
24	10	16	14

3. *Installation.* Apply over solid sheathing or sheathing spaced on centers equal to shingle exposure. If applied over sheathing other than wood boards or plywood, special methods of attachment acceptable to the Chief Underwriter shall be used.

4. *Nailing.*

a. Nails shall be copper, hot-dipped galvanized or aluminum. See note following 410–A–3–d.

b. Butt-nail double coursing; exposed nails shall be small-headed.

410–C. Asbestos-Cement Siding and Shingles.

1. Apply clapboards and shingles in accordance with manufacturer's recommendations.

2. Apply over solid sheathing. If applied over sheathing other than wood boards or plywood, special method of attachment acceptable to the Chief Underwriter shall be used. Application over nailing strips is not acceptable except as provided in 408–H–3–d and 408–H–4–d.

3. Nails or other means of attachment shall be non-corrodible.

410–D. Plywood.

1. *Grademark.* Each sheet shall be identified with the manufacturer's official insignia indicating that the plywood is for exterior use.

2. *Sheathed walls.* Plywood ¼-inch thick may be used on sheathed walls. If sheathing other than wood is used, install solid blocking between studding as provided in D–4.

3. *Unsheathed Walls.*

Minimum thickness (inches)	*Maximum stud spacing (inches o. c.)*
3/8	16
1/2	20
5/8	24

4. *Installation.*

a. Protect edges prior to erection with paint, mixed 100 pounds white lead paste, 1¾ gallons raw linseed oil and 1 pint dryer, applied without thinning, or other material acceptable to the Chief Underwriter.

b. Vertical joints shall occur over studs.

c. Horizontal joints: install solid blocking between studding for nailing.

d. Butt-joints of square-edge material, whether exposed or covered by battens, shall be filled with mastic.

e. Corner boards shall be applied over plywood or plywood shall be butted against intersecting boards at all corners.

f. Nailing. Nails shall be hot-dipped galvanized or aluminum,* flat head. Maximum spacing, on edge, 6 inches o. c.; at intermediate bearings, 12 inches o. c.

*See note following 410–A–3–d.

410–E. Stucco.

1. *Stucco Plaster.*

a. Mixture: one part portland cement, three parts sand, and hydrated lime equal to 10 percent of cement by volume; or prepared portland cement stucco used in accordance with manufacturer's recommendations.

b. Thickness: 2-coat work, 5/8-inch total.

c. Application:

(1) 2-coat work shall be used over masonry surfaces.
(2) Finish coat may be trowel coat of prepared exterior stucco.
(3) Thoroughly cover and embed lath in stucco.
(4) Keep wet three days after application of each coat.
(5) Stucco shall not be applied when temperature is less than 40° F.

410–F. Exterior Wood Trim.

1. *General.* The species and grade of exterior wood trim shall be appropriate for the proposed use and this, together with workmanship in its installation, shall be of a quality suitable for the class of dwelling under consideration and shall be acceptable to the Chief Underwriter.
2. All exterior trim shall be thoroughly seasoned and kiln-dried, and sanded free of tool marks and other objectionable defects.
3. Moisture content at the time of installation shall not exceed 12 percent.
4. *Nailing.* Set face nails and seal with putty after prime coat of paint, unless hot-dipped galvanized or aluminum nails are used, in which case setting and puttying of nails may be omitted if acceptable to the Chief Underwriter.

ROOF COVERINGS

411–A. General.

1. *Double starting row* shall be used on all shingle applications.

2. *Nails* for attaching roof coverings shall be copper or hot-dipped galvanized nails or aluminum nails when acceptable to the Chief Underwriter.

3. *Gable and rake cornices* shall provide a weather tight joint.

4. *Modifications.* When materials and methods of application provide precautions in excess of these minimum requirements to assure a weather-tight roof, the roof slopes listed herein may be modified subject to acceptance by the Chief Underwriter.

411–B. Asphalt Shingles.

1. *Label.* Fire Underwriters' Class C label shall appear on each bundle.

2. *Slope,* 4 in 12 minimum, except porches which may be 3 in 12 minimum.

3. *Approximate minimum weights* per square (shipping weights):

a. Square butt strip	210 pounds
b. Hexagonal strip	215 pounds
c. Individual shingles	250 pounds
d. Interlocking shingles	215 pounds

4. *Exposure* as required for Fire Underwriters' Class C label.

5. *Headlap* shall be as recommended by manufacturer; minimum, 2 inches.

411 – B. Asphalt Shingles. *Continued.*

6. *Coverage.* The roof covering after application shall provide at least double thickness at all points. Cutouts and spacings between shingles not in excess of ¾-inch may be disregarded in determining compliance with this requirement.

7. *Installation.* All shingles shall be applied and nailed in accordance with the recommendations of the manufacturer.

8. *Underlay.*

a. Asphalt-saturated felt: weight approximately 15 pounds per 100 sq. ft.; or

b. Underlay may be omitted when triple thickness is obtained at all points.

9. *Cementing.* In areas where high winds are a hazard, each tab of shingles shall be secured by spot cementing with special cement recommended by the manufacturer for the purpose or by other methods acceptable to the Chief Underwriter.

10. *Drip strip* for asphalt shingles shall be 26-gage galvanized metal with 1½-inch flange on roof nailed 6 inches o. c. with ¾-inch galvanized nails.

411–C. Wood Shingles.

1. *Shingles* shall be edge grain, tapered shingles, No. 1 grade.
2. *Slope,* 4 in 12 minimum, except porches which may be 3 in 12 minimum.
3. *Minimum size.*

Length (inches)	*Thickness*
16	5 butts in 2 inches
18	5 butts in 2¼ inches
24	4 butts in 2 inches

4. *Maximum Exposure.*

Slope of roof		*Exposure for shingle length (inches)*		
Rise	*Run*	*16*	*18*	*24*
Under 5	12	3¾	4¼	5¾
5 and over	12	5	5½	7½

5. *Underlay* is not required.

6. *Drip strip* for wood shingles shall be 26-gage galvanized metal with 1½-inch flange on roof nailed 6 inches o. c. with ¾-inch galvanized nails.

411–D. Asbestos-Cement Shingles.

1. *Quality.* Dense, hard structure and thoroughly seasoned.

2. *Slope,* 4 in 12 minimum except porches which may be 3 in 12 minimum.

3. *Install* according to manufacturer's directions.

4. *Underlay* shall be one layer of asphalt saturated asbestos or rag felt, not less than 15 pounds per 100 square feet.

5. *American Method.*

a. Standard shingle: minimum weight per square 470 pounds.

Length of shingle (*inches*)	*Maximum exposure* (*inches*)
16	7
15	6½
12	5

b. Strip shingle: minimum weight per square, 250 pounds.

6. *Dutch Method.*

a. Minimum weight per square, 265 pounds.

b. Minimum head lap, 3 inches.

c. Minimum side lap, 4 inches.

7. *French or Hexagonal Method.*

a. Minimum weight per square, 250 pounds.

b. Minimum overlap 2 edges, 3 inches.

8. *Drip strip* for asbestos-cement shingles shall be 26-gage galvanized metal with 1½-inch flange on roof nailed 6 inches o. c. with ¾-inch galvanized nails.

411–E. Tile Roofing.

1. *Quality.*

a. Hard-burned clay tile.

b. Concrete roofing tile. See Use of Materials Bulletin "Concrete Roofing Tile" (latest edition), for manufacture.

2. *Slope,* minimum 2½ in 12, maximum 5 in 12 unless each tile is nailed in place and installation is acceptable to the Chief Underwriter.

3. *Underlay.* Install one 30-pound dry sheet as required by 411–G–6–b and one layer of 90-pound mineral-surfaced roll roofing with 2-inch head lap mopped on the 30-pound felt with hot asphalt. One layer of 30-pound felt and two layers of 15-pound felt with 19-inch laps mopped between layers and on the surface may be substituted for the 90-pound mineral surfaced roll roofing. The surface shall be sprinkled with clean dry sand while the asphalt is hot. Install drip strip at all eaves and gable ends.

4. *Installation.* All tile to be set on roof in bed of mortar not less than 1 part cement to 3 parts sand and not more than 25 percent lime by volume. Provide full bed of mortar between all head and side laps. Head laps on both shingle and barrel tile shall be not less than 2½ inches and side lap for barrel tile 1½ inches. Extend tile beyond sheathing not less than ¾

411 – E. Tile Roofing. *Continued.*

inch and not more than 1½ inches at eaves. Eaves of barrel tile shall be filled solid with mortar, and weep holes provided. When not in conflict with these requirements, installation shall be in accordance with the manufacturer's directions.

5. *Shingle tile, American Method.*

Length of shingle (*inches*)	*Maximum exposure* (*inches*)
16	7
15	6½
14	6
12	5

6. *Drip strip* under tile roofs shall be 26-gage galvanized metal, installed over the 30-pound dry sheet with 1½-inch flange on roof nailed 6 inches o. c. with ¾-inch galvanized nails.

411–F. Slate Shingles.

1. *Quality.* Slate shall be free from knots or knurls and of reasonably smooth cleavage.

2. *Slope,* minimum 4 in 12, except porches which may be 3 in 12 minimum.

3. *Underlay* shall be approximately 30-pound asphalt saturated felt.

4. *American Method.*

a. Minimum thickness, 3/16-inch.

Length of shingle (*inches*)	*Maximum exposure* (*inches*)
18	7½
16	6½
14	5½
12	4½
10	3½

5. *Special methods.* Slate shingles laid by other than American method may be used if acceptable to Chief Underwriter.

6. *Drip strip* for slate shingles shall be 26-gage galvanized metal with 1½-inch flange on roof nailed 6 inches o. c. with ¾-inch galvanized nails.

411–G. Built-up Roofs.

1. *Materials* used in the construction of built-up roofing shall comply with requirements of Underwriters Laboratories, Inc.

2. *Slope.*

a. Roofs surfaced with gravel or crushed stone, 2½ in 12 maximum.

b. Roofs surfaced with mineral surfaced cap sheet, 2½ in 12 minimum.

3. *Coverage.* The covering shall include at least 3 plies applied according to manufacturer's directions.

4. *Each ply of felt:* minimum weight 13 pounds per 100 square feet. Where mineral surfaced cap sheet is used, top ply of felt may be omitted.

5. *Surface roofs with:*

a. Roofing gravel or crushed stone, weight approximately 400 pounds per 100 square feet up to 1 in 12 pitch; 275 pounds per 100 square feet at 3 in 12 pitch (proportionately in between); or

b. Crushed slag, weight approximately 300 pounds per 100 square feet

c. Mineral surface cap sheet, minimum weight 85 pounds per 100 sq. ft.

6. Preparation:

a. All roofing felts shall be laid before a gravel stop is installed.

b. The dry sheet consisting of not less than one 30# felt (or two 15# felts shingled in) on all roofs, excepting exposed ceilings, shall be tintagged 6″ o. c. on head laps and 12″ o. c. in field both ways between laps, with tin caps and roofing nails of not less than 1″ in length.

c. For exposed rafters, the above dry sheet shall be tintagged 6″ o. c. on all rafters vertically with tin caps and roofing nails not less than 1¼″ long; in field between rafters, tintagged 12″ o. c. with nails not longer than ¾″.

d. Rigid board insulation over wood decks to be tintagged not less than 12″ o. c. all directions and penetrate at least ¾″ into the wood sheathing. All roofing felts shall be mopped solid to insulation board.

e. Over concrete decks, insulation board shall be mopped solid to deck.

f. Gravel stop and drip strip. Metal shall not be less than 26-gauge galvanized iron, 16 oz. copper, or 0.025 aluminum. Flange on roof for gravel stop shall be 3″ in width, and nailed with not less than ¾″ non-corrosive nails, spaced 6″ o. c. staggered. Seal along edge directly in back of gravel stop with a plastic compound, then mop on two layers of 15# felt, on 6″ strip, then one 9″ strip to cover flange. Gravel shall be thoroughly imbedded in flood coat of asphalt. Gravel stop shall extend below roof sheathing.

411–H. Metal Roofs.

1. *Materials.*

a. Galvanized sheet metal: 26-gauge, 1.25-ounce (total weight both sides) zinc coating per square foot, painted on exposed side after priming with zinc-dust zinc-oxide primer or treatment acceptable to the Chief Underwriter.

b. Copper: 16-ounce soft (roofing temper).

c. Terneplate: IC or IX, 40-pound coating, painted both sides.

d. Aluminum. See FHA Use of Materials Bulletin on Aluminum Building Products.

2. *Nails.*

a. Hard copper or copper alloy shall be used for copper roofs.

b. Hot dipped galvanized nails for galvanized sheet metal roofs.

411 – H. Metal Roofs. *Continued.*

3. *Seams and joints* shall be locked or soldered and made watertight.

4. All metal roofs shall be grounded.

411–I. Other Types of Roof Coverings. Roof coverings, such as metal shingles, canvas decks, etc., may be used when the type and weight of material, and method of application are acceptable to the Chief Underwriter.

FLASHING

412–A. Materials.

1. *Copper* shall be 16-ounce soft (roofing temper).

2. *Galvanized sheet metal* shall be 26 gauge, 1.25-ounce (total weight both sides) zinc coating per square foot, painted on exposed side after priming with zinc-dust zinc-oxide primer or treatment acceptable to the Chief Underwriter.

3. *Lead:* hard lead, 2 pounds; soft lead, 4 pounds.

4. *Terneplate:* IC or IX, 40-pound coating, painted both sides.

5. *Other materials* as provided for specific purposes in this section.

412–B. Openings.

NOTE.—*Flashing at heads of openings may be omitted when vertical height from head of opening to soffit of eaves is at least one-quarter less than effective projection of eaves from face of wall.*

1. *Heads of openings, wood frame walls.*

a. Sheet metal shall extend behind finish siding material and be turned down over outside edge of drip cap; or

b. Three-ounce copper-coated building paper may be used provided flashing is not exposed to weather more than 2 inches. Extend flashing behind siding. Blind tack at outside edge of drip cap, 1 inch o. c.

2. *Heads and sills of openings, masonry-veneered wood frame walls.* See detail 45.

a. Material shall be sheet metal or 3-ounce copper-coated building paper. Other materials designed for this purpose and so recommended by the manufacturer may be used subject to the acceptance of the Chief Underwriter.

b. Head flashing shall extend from front edge of lintel, up and over top of lintel and up on sheathing under sheathing paper.

c. Sill flashing shall extend under masonry sill and up to underside of wood sill.

3. *Heads and sills of openings, masonry walls.* See detail 46.

a. Material shall be sheet metal or 3-ounce copper-coated building paper. Other materials designed for this purpose and so recommended by the manufacturer may be used subject to the acceptance of the Chief Underwriter.

b. Head flashing shall extend from front edge of lintel, up and over top of lintel through wall and turn up 1 inch on inside surface.

c. Sill flashing shall extend under and behind masonry sill.

412–C. Intersections, Stucco and Other Materials. Use sheet metal flashing at all horizontal and vertical intersections.

412–D. Valleys.

1. *Rigid shingle roof covering.*

a. Flash with sheet metal.

b. Flashing on roofs of slopes less than 7 in 12, minimum width of flashing 18 inches; on roofs of slopes 7 in 12 or more, minimum width of flashing 12 inches.

2. *Asphalt shingle roof covering.*

a. Flash with sheet metal; or

b. Two thicknesses of mineral surfaced roll-roofing shall be used, cut from rolls weighing not less than 85 pounds per square. Bottom strip shall be not less than 12 inches wide; top strip, at least 18 inches wide.

c. One thickness of 55-pound roll roofing 36 inches wide when closed or woven asphalt strip shingle valley treatment is used.

412–DD. Eaves and Gables. Provide drip strip at eaves and gables of all roofs.

412–E. Roof and Wall or Parapet Intersections. Intersections shall be flashed. If walls are of masonry or masonry veneer, sheet metal counter-flashing shall be installed.

1. *Sloping roof.* Use sheet metal flashings.

2. *Flat roof.* Use sheet metal or same material as roof covering. Install 45 degree cant strip at roof and wall intersection.

412–F. Terrace and Porch Slabs. Flash along all edges which abut wood construction to completely separate wood from masonry or concrete. See Detail 9.

1. Flashing material shall be sheet metal.

2. Flashing shall extend from ½-inch beyond inside face of foundation wall, across top of foundation (beneath wood sill) to outside face of wall; turn flashing up behind exterior wall finish to a point 4 inches above top of slab; fold or turn flashing down at this point and extend to top of

412 – F. Terrace and Porch Slabs. *Continued.*

slab and thence out on slab (beneath exterior wall finish) projecting ¼-inch beyond the outside face of wall finish. See detail 9.

3. If termite protection (see 409) is by use of:

a. Termite shields. Soldered or locked seam connection shall be made between terrace or porch slab flashing and shields. Use same material for flashing as is used for shields.

b. Concrete capped masonry foundations or wood preservative treatment. The flashing shall cross through wall under cap or under top course of solid masonry.

c. Poured concrete foundation. The ends of the flashing shall be sealed in dense concrete or coal-tar pitch.

4. Masonry planting beds shall be separated from wall a minimum of 4 inches.

412–G. Chimneys. See detail 47.

1. All chimney and roof intersections shall be flashed and counterflashed with sheet metal flashings extending into masonry.

2. Cricket or saddle covering shall be sheet metal or when acceptable to the Chief Underwriter, same material as roof covering. When other than sheet metal is used, the material shall be flashed and counterflashed at the chimney with sheet metal.

412–H. Pipes Projecting Through Roof.

1. Flash with flange extending beyond the sleeve at least 6 inches on all sides.

2. On sloping roofs, increase top flange proportionately when exposure of roofing units exceeds 5 inches.

3. Seal joint between pipe and sleeve with mastic, or counter-flash.

GUTTERS AND DOWNSPOUTS

413–A. Gutters and downspouts shall be installed on all roofs unless omission is acceptable to the Chief Underwriter.

413–B. Materials.

1. *Copper.* 16-ounce, hard (cornice temper). All copper eaves trough, gutter, and conductor pipe to be embossed (not stenciled) with the weight in ounces per square foot of the copper from which these items are made, in accordance with SPR 29.

2. *Galvanized sheet metal* shall be 26 gauge, 1.25-ounce (total weight

both sides) zinc coating per square foot, painted both sides after priming with zinc-dust zinc-oxide primer or treatment acceptable to the Chief Underwriter, except that painting of inside of downspouts is not required. All galvanized eaves trough, gutter, and conductor pipe to be embossed (not stenciled) with the gauge number of the galvanized sheet steel from which these items are made, in accordance with U. S. Department of Commerce, SPR 29.

3. *Solid wood gutters.* Install with ¼″ x 1″ vertical furring strips 2 feet o. c. Paint furring strips and back of gutter two coats of paint before installation. Paint inside of gutter with two coats pitch or three coats lead-in-oil paint after installation.

413–C. Roof Water Disposal.

1. Splash blocks at bottom of downspouts shall be constructed of concrete or other material acceptable to the Chief Underwriter. Extend to carry water at least 3 feet from building; or

2. Connect downspouts to tile drain emptying into a dry well located in accordance with the requirements in section 606. In no case shall the dry well be less than 10 feet from the dwelling; or

3. Connect to sewer, or other outlet acceptable to the Chief Underwriter.

4. When gutters are omitted, eaves shall project at least 6 inches from exterior face of wall.

INTERIOR WALL AND CEILING FINISH

414–A. Lath and Plaster.

1. *Wood Lath.*

a. Maximum stud spacing, 16 inches o. c.

b. Lath, No. 1, 5/16-inch thick.

c. Space lath ¼- to ⅜-inch apart; break joints every seventh lath; nail at each bearing.

2. *Expanded Metal Lath.*

a. Painted or galvanized lath.

b. Minimum weights: maximum spacing of supports.

Use	*Pound per square yard*	*Stud or joist spacing (inches)*
Walls	2.5	16
	3.4 flat-rib	20
	4.0 flat-rib	24
Ceilings	2.75 flat-rib	16
	3.4	16
	3.4 ⅜-rib	24

414–D. Dry-Wall Finish.

1. *Minimum thickness.*

Type of finish	*Spacing of framing members (inches)*		
	16	*20*	*24*
Plywood	¼	*¼	⅜
Gypsum board	⅜	½	*½
Fiber board	½	¾	¾

**Apply long dimension at right angles to framing members.*

2. *Blocking.* For stud spacing exceeding 16 inches o. c., solid blocking shall be installed behind all joints at right angles to framing members unless joints are reinforced.

3. *Other types of boards,* including compressed dense composition board less than ½-inch thick may be used when acceptable to the Chief Underwriter.

4. *The method of application* and of joining dry-wall finish shall be in accordance with the manufacturer's recommendations and subject to the acceptance of the Chief Underwriter.

5. Protect all external corners of dry-wall finish with rust resistant angles or other material acceptable to the Chief Underwriter.

414–E. Wood Trim.

1. *General.* The species and grade of interior wood trim shall be appropriate for the proposed use and this, together with workmanship in its installation, shall be of a quality suitable for the class of dwelling under consideration and shall be acceptable to the Chief Underwriter.

2. All interior trim shall be thoroughly seasoned and kiln-dried, and sanded free of tool marks and other objectionable defects.

3. Moisture content at the time of installation shall not exceed 12 percent.

4. Plaster and other building materials shall be dry at time of installation of trim.

5. All nail heads shall be set for putty seal.

FINISH FLOORS. *Finish floors shall be installed.*

415–A. Cement Floors.

1. *Mix.* See 406–B.

2. *Heater Rooms, or floors under heaters.*

a. Cement floors installed on ground, see 406–E.

b. When installed on wood framing: minimum thickness, 4 inches. Use sheet metal over tops of joists for concrete forms, or cut in 1-inch boards flush with tops of joists; remove boards after slab has set. Reinforce slab

with wire mesh weighing not less than 30 pounds per 100 square feet, or with ¼-inch bars spaced 1 foot o. c. each way. See Appendix E, 1–A.

415–B. Wood Floors.

1. *Materials.*

a. Flooring shall be kiln-dried material.

b. Strip flooring:

(1) Hardwood, minimum thickness over subflooring, $^{5}/_{16}$-inch; for single thickness floorings, $^{25}/_{32}$-inch.

(2) Softwood, minimum thickness, $^{25}/_{32}$-inch.

(3) Maximum width for hardwood, 2¼ inches; for softwood, 3¼ inches. Wider widths including plank flooring may be used when precautions are taken in installations to prevent warping or cupping.

c. Nails: use steel cut nails for flooring $^{25}/_{32}$-inch (finish) thickness; for flooring less than $^{25}/_{32}$-inch in thickness use bright wire casing nails.

d. Building paper or deadening felt shall be applied under all finish flooring. Under single floors, over basementless spaces, 15-pound asphalt saturated felt shall be applied over joists with 4 inches minimum lap unless floor is insulated.

e. Bituminous primer when used with sleepers or wood block flooring on concrete shall be one part of bituminous adhesive to three parts of thinner. Thinner to be petroleum distillate, 95 percent distilling between 305° F. and 390° F.

2. *Installation.*

a. Finish flooring installed over subflooring shall be applied at right angles to wood board subflooring except when subflooring is laid diagonally. If applied over plywood, see 408–C–4–d. Single flooring shall have end joints over joists unless end-matched; if end-matched, no two adjoining strips shall break joints over same joist space, each strip shall bear on at least two joists.

b. Strip flooring installed over concrete shall be applied on pressure treated wood sleepers secured to concrete.

(1) Sleepers embedded in concrete or secured with metal clips to concrete shall be not less than 2 x 2 inches.

(2) Sleepers secured to concrete with bituminous adhesive shall be not less than 2 x 4 inches, not over 12 inches on centers, not less than 18 inches nor more than 30 inches long and shall be laid flat at right angles to the direction of the flooring. Sleepers shall be staggered with ends lapped at least 3 inches for 2¼-inch and 4 inches for 3¼-inch flooring widths. Apply bituminous adhesive in accordance with d. below.

415 – B. Wood Floors. *Continued.*

(3) Moisture content of sleepers not to exceed 19 percent.

c. Wood block flooring applied over concrete shall be set in bituminous adhesive and installed in accordance with flooring manufacturer's directions. Apply bituminous adhesive as in d.

d. Application of bituminous adhesive to concrete: Clean concrete to be primed with bituminous primer. Apply bituminous adhesive 3/32-inch thick over entire surface at temperature not less than 175° F. before setting wood block flooring or sleepers.

415–C. Ceramic Tile. See 408–C–4–c.

1. *Grade* shall be standard grade or better.

2. *Setting bed.* See details 36 and 37.

a. Mix: I part portland cement, 4 parts sand; or 1 part portland cement, 2 parts sand and 4 parts pea size aggregate.

b. Minimum thickness: 1¼ inches, reinforced with wire mesh.

3. When applied over wood subfloor, install asphalt saturated felt over subfloor underneath the wire mesh. See details 36 and 37.

415–D. Composition Flooring. Asphalt tile, rubber tile, linoleum and plastic tile shall be installed in accordance with the manufacturer's instructions, subject to acceptance by the Chief Underwriter.

GLAZING

416–A. Window Glass.

1. Minimum, B quality.

2. Factory-labeled on each pane.

3. Glass panes exceeding 12 inches in least dimension when installed in doors shall be not less than double strength.

416–B. Installation.

1. *Exterior work.*

a. Glass set in wood shall be secured in place with sprigs or glazing points and face-puttied. In doors, bed in putty and secure with wood stops.

b. Glass set in metal shall be back-puttied and secured with glazing clips. Use special putty for metal windows.

2. *Interior work.* Secure glass in place with stops or glazing beads.

3. *Mirrors:* install on wood blocks. If in doors, use felt cushions. Provide air space in back of mirror for ventilation.

417–A. Exterior Work. Exterior work shall be finished as follows:

1. *Millwork, siding and other exterior wood surfaces.*

a. Prime coat shall be applied before or immediately after installation.

b. Nail holes and cracks shall be puttied after prime coat. Tint putty to match stained and varnished work.

c. Paint: minimum of 3 coats, including prime coat. See 417–A–9.

d. Varnish: use specially prepared varnish where varnish finish is proposed; its use should be limited to surfaces which are protected from the weather.

2. *Wood shingles.*

a. Sidewalls: apply 2 coats stain or paint.

b. Roofs: apply stain or paint or leave unfinished.

3. *Cedar, cypress, and redwood* may be finished by methods acceptable to Chief Underwriter.

4. *Top and bottom of exterior doors,* casement sash and bottoms of double-hung sash, paint at least 2 coats.

5. *Sheet metal* shall be painted at least two coats, including zinc-dust zinc-oxide primer if used, except as provided in FHA Use of Materials Bulletin, *Aluminum Building Products.* See 409–D, 411–H, 412–A and 413–B.

6. *Masonry.* Where waterproofing of exterior face of masonry or stucco exterior walls is required, a minimum of two coats of paint shall be applied.

a. Open texture walls: Concrete block construction shall be waterproofed.

(1) Cement-water paint. All cement-water paint shall comply with Federal Specifications TT–P–21, Type II. All containers shall bear the following printed statement: "This cement-water paint complies with Federal Specification TT–P–21, Type II Cement-water Paint." First coat: Use Type II, Class B (with fine silica sand); the sand used shall pass a No. 20 sieve. Second coat: Use Type II, either Class B or Class A (with or without sand).

(2) Ready-mixed paints of oil-base, synthetic resin-emulsion, vinyl synthetic resin, oil-emulsion, and rubber-emulsion types and job-mixed white lead-in-oil paint for concrete, stucco, brick and similar masonry surfaces.

(3) All paint shall be mixed strictly in accordance with manufacturer's instructions.

b. Smooth surface walls (such as brick and stucco). Paint requirements shall be the same as in paragraph a, except that if cement-water paint is used, the first coat need not contain the sand aggregate.

417 – A. Exterior Work. *Continued.*

c. Application. All paint shall be applied by brush.

(1) Open texture walls (such as concrete block). Apply first coat by scrubbing paint on with stiff bristle brushes such as scrubbing brushes or fender brushes. Second coat may be brushed on with calcimine or whitewash brushes, if desired.

NOTE.—*After the application of cement-water paint, special attention should be given to curing by sprinkling gently with water for several days.*

(2) Smooth textured walls. If desired, both coats may be applied with calcimine or whitewash brushes.

7. *Poured concrete, stucco, and masonry* other than as required in 6. When painted: apply 2 coats of masonry paint; mix and apply as recommended by manufacturer.

8. *Ornamental iron, structural steel, and steel sash* shall be painted with lead-in-oil, graphite or prepared paint, as recommended by manufacturer. One or more coats in addition to shop coat.

9. *Specially prepared paints* which necessitate modification of above requirements may be used when acceptable to the Chief Underwriter.

10. *Additional coats.* In all cases of exterior paintwork, if the finish paint jobs does not provide proper protection and hiding, the Chief Underwriter may require additional coats before acceptance.

417–B. Interior Work. Finish interior work in a manner acceptable to the Chief Underwriter. Bathrooms and kitchens shall have walls, ceilings, and woodwork painted with a semigloss or gloss enamel paint or other finish acceptable to the Chief Underwriter.

1. Plaster, other than in bathrooms and kitchens, may be painted, papered, or left natural.

a. If painted, minimum acceptable:

(1) Apply varnish size or specially prepared primer and two coats oil or varnish base paint.

(2) Apply casein size and one coat casein paint.

(3) Apply size and one coat resin emulsion.

(4) Special paint finishes may be used when applied and finished in accordance with manufacturer's instructions provided they are acceptable to the Chief Underwriter.

b. If papered:

(1) Size plaster with glue size.

(2) Use wall paper of quality commensurate with quality of dwelling.

2. Wallboard or paneled walls, other than in bathrooms and kitchens: stain, paint, or paper. Apply finish according to manufacturer's directions.

3. Wood trim, sash and doors, other than in bathrooms and kitchens, including tops and bottoms and paneling shall be finished.

a. If painted: minimum acceptable, one prime coat and one finish coat; and if open-grain wood: one coat filler before application of paint coats.

b. If stained: stain and one coat of varnish; or stain and one coat wax. If smooth finish is desired on open-grain wood use filler after stain.

c. If natural wood finish: two coats varnish; or two coats wax; or one coat varnish and one coat wax.

417–C. Wood Floors. Wood floors shall be sanded and finished.

1. Open-grain wood, one coat filler.

2. Minimum finish, all wood floors:

a. Two coats wax.
b. Stain and two coats wax.
c. One coat shellac, varnish or lacquer and one coat wax.
d. Two coats varnish.
e. Two coats floor enamel and one coat wax.
f. One coat sealer and two coats wax.
g. Three thin coats shellac.
h. Flooring prefinished at the factory may be used when acceptable to the Chief Underwriter.

417–D. Cement Floor Finish. When painted, neutralize all cement floors; apply two coats floor paint and one coat wax.

417–E. Metal.

1. Structural steel and iron and exposed surfaces of miscellaneous steel and iron shall have one coat rust inhibiting paint in addition to shop coat.

2. Ornamental iron shall have one coat rust inhibiting paint and one finish coat unless specially finished.

FINISH HARDWARE

418–A. General. Install hardware of quality commensurate with class of dwelling.

418–B. Exterior Hardware Material.

1. Bronze.

2. Brass.

3. Ferrous metals when zinc or cadmium coated, or phosphate treated before painting.

418–C. Exterior Doors.

1. Use three butts. Where door swings outward, fixed-pin butts shall be installed.

2. Install cylinder type lock on all entrance doors. Where door swings outward, provide dead-bolt.

GARAGES

419–A. Attached or Built-in Garages.

1. Construction shall be consistent with that of the dwelling.

2. If door opening occurs between garage and dwelling the garage floor shall be sloped away from that door to provide positive drainage.

3. Install partition between space containing house heating unit and garage space. Do not install house heating unit in garage space.

4. Wood frame walls and ceilings common to dwelling and garage shall be finished on garage side in a manner acceptable to Chief Underwriter.

419–B. One-story Detached Garages. Comply with construction requirements for one-story dwellings with the following exceptions:

1. Bottom of footings of frame garages shall be not less than 12 inches below finish grade, except in areas where bearing is on solid rock, minimum may be 6 inches.
2. Studs, maximum spacing 24 inches o. c. Doubling of studs is not required on jambs of openings less than 3 feet 6 inches wide.
3. Sheathing and building paper may be omitted.
4. Corner post may be two 2 x 4's or a 4 x 4.
5. Top plate may be single, provided rafters occur over studs, and plates at corners are lapped to provide ties.
6. Rafter ties at eaves may be 2 x 4's maximum spacing 6 feet o. c.
7. Corner bracing may be applied on the inside surface of studs.
8. Flooring may be slag, gravel, cinders or other material acceptable to the Chief Underwriter. If concrete see 406–E.
9. . Masonry garages shall have wall and foundation requirements same as for one-story dwellings.

HEATING REQUIREMENTS

500. Objective. *The objective of heating requirements is to assure (a) winter comfort by means of facilities providing a quality of performance as well as economy and convenience of operation; and (b) an adequate supply of hot water; both appropriate to the dwelling under consideration.*

GENERAL. *See 401. See also Appendix E for Detailed Heating Requirements, which are a part of these Heating Requirements.*

501–A. Facilities for Heating.

1. Each dwelling shall be provided with facilities for heating. The heating equipment shall be new and durable, completely connected, in operating condition and properly balanced and adjusted at the time of final compliance inspection. The complete installation shall be safe, efficient, and economical in operation and shall provide an acceptably uniform distribution of heat throughout the dwelling.

2. Minimum acceptable quality of performance and the degree of convenience of operation shall at least be in conformance with the class of dwelling.

3. Provide facilities for fuel storage as required in 302–C–7.

4. See 302–C–8 for requirements pertaining to space for heating. If no heating unit or system is specified, a flue suitable for any fuel shall be installed at the space designated for the heating unit. When a heating unit or system is specified for fuel-burning systems, a flue shall be provided suitable for the type of system proposed. If an electric heating system is specified, electric service connection and suitable outlets for the equipment specified shall be provided.

501–B. Safety.

1. The installation of equipment shall comply with all applicable local laws and ordinances and with the current standards, regulations and recommendations published by the National Board of Fire Underwriters.

2. Coal-fired equipment shall not be installed on any floor above the first floor.

3. The products of combustion from all *specified* house and water-heating equipment shall be discharged outside the dwelling through a suitable masonry chimney or Underwriters Laboratories, Inc., listed flue or vent. If no heating equipment is specified, one suitable masonry chimney, or a flue or vent listed by the Underwriters Laboratories, Inc. for the likely fuel or fuels shall be provided at a logical location for future installation of adequate, vented-heating equipment. Gas outlets for house heating shall not be specified or shown on drawings at locations not convenient to a chimney, flue or vent. In areas where the use of unvented *natural gas-*

501 – B. Safety. *Continued.*

fired bathroom heaters is the usual practice unvented bathroom heaters may be accepted, provided:

a. The AGA listed input to the bathroom heater in Btu does not exceed 30 times the bathroom volume in cubic feet, and

b. Two openings are installed, one placed high in wall, door or ceiling and one low in wall, floor or door or below door. Free area of each opening to be not less than 1 square inch (2 square inches if screened) for each 1,000 Btu AGA input rating for heater.

4. The construction of all heating equipment and domestic water heating equipment and appurtenances shall conform to the requirements in applicable Codes and Standards.

5. Warm air distribution systems, either gravity or forced, shall be so arranged that the return ducts serving one living unit are not connected with those serving any other living unit and air returned from one living unit shall not be recirculated to another living unit.

6. Public halls shall not be used as plenums in warm air distribution systems.

501–C. Capacity of Heating Equipment.

1. The output capacity of a heating system, after deductions have been made for piping and pick-up losses, attached domestic hot-water heaters, and other connected loads shall be not less than the heat loss of the living unit or dwelling.

2. The output of overflow heaters, radiators, convectors, registers or other heat distribution devices shall be not less than the heat loss of the space or spaces which are to be heated. Distribution shall be proportioned to the heat losses of such space.

NOTE.—*Heat loss is the amount of heat in Btu per hour which escapes from the heated space in a dwelling, assuming that the temperature of that space is maintained at an acceptable comfort temperature and the distribution is acceptably uniform, when the outside temperature is at the design temperature established for the locality by the FHA Insuring Office.*

501–D. Design, Installation and Rating. Compliance is required with design, rating and installation requirements of applicable Codes and Standards acceptable to the Chief Underwriter.

501–E. Tests and Operating and Maintenance Instructions.

1. Tests, certifications and other data, when required to determine compliance with plans, specifications and requirements, shall be subject to the acceptance of the Chief Underwriter.

2. Printed guarantees, service agreements, operating and maintenance instructions regularly furnished by the manufacturer and installer or as may be additionally required by the Chief Underwriter, shall be posted on or adjacent to the equipment to which they apply, before final inspection.

501–F. Special Methods. Any proposed method of heating the dwelling or heating domestic hot water not covered by these requirements shall be considered a special method. In such cases the data to be submitted and the procedure to be followed for determination of acceptability are described in Federal Housing Administration Technical Circular No. 4, Part II, "Special Mechanical Equipment," as currently effective.

DOMESTIC WATER HEATING AND STORAGE

502–A. Facilities. Each dwelling shall be provided with new, durable, and economical facilities for supplying year-round domestic hot water. Equipment shall be installed so as to permit ready access for repair and replacement and shall be completely connected and in safe operating condition at time of final inspection.

502–B. Capacities. Storage capacity and recovery rate shall be appropriate to the type, class, and size of dwelling proposed and fixtures and equipment to be served. Tanks, other than those made of monel metal or copper, of less than 30 gallons capacity, shall not be accepted, except that for a one-bedroom, one-bathroom unit a 20-gallon tank may be accepted.

502–C. Controls and Safety Requirements.

1. *Electric and oil- or gas-fired water heaters,* except indirect heaters connected to the house heating boiler, shall be AGA or UL listed and labeled.

2. *Automatic storage-type heaters* shall be equipped with a temperature-limiting device which cannot be set above 160° F. unless monel metal or copper tanks are used.

3. *Automatic equipment* which is installed and controlled so as to be capable of delivering water in excess of 160° F. shall have an automatic mixing valve or equivalent device installed to prevent delivery of water in excess of 160° F. except to special equipment such as automatic washing machine or dishwasher.

4. *All storage tanks* shall be provided with AGA listed, labeled, and BTU rated or ASME labeled and BTU rated temperature- and pressure-relief valves (separate or combined), except that a temperature-relief valve may be omitted when the storage tank is indirectly heated or where the water heating device is equipped with an AGA or UL listed, automatic, emergency energy (gas, oil, or electricity) shut-off of the manual re-set type (in addition to the operating control). The pressure-relief valve shall be conveniently located and shall be set to discharge at approximately 10 pounds per square inch above the highest normal static water pressure. The temperature-

502–C. Controls and Safety Requirements. *Continued.*

relief valve shall be placed in the top of the tank or in the hot water discharge, directly above the tank served, and in no case more than 3 inches away from the tank, and shall be set to discharge at a temperature not in excess of 210° F., and shall have a rated capacity in excess of the burner input capacity. There shall be no check valve or shut-off valve between a relief valve and the tank for which it is installed or on the discharge line from the valve.

5. *In the absence of specific applicable requirements* regarding water heaters all matters of fire safety and compliance with provisions of NBFU, AGA and UL; Commercial standards; clearance from combustible construction; flues, vents, and connections thereto; dampers and draft diverters; fuel storage and piping and electric wiring shall be as required for house heating equipment of equivalent burner capacity. Vent all fuel-burning water heaters.

6. *Domestic water heating surface* exposed to direct flames or hot gases in a furnace or boiler used for house heating is not acceptable.

502–D. Hot Water Storage Tanks.

1. *Tests.* Storage tanks shall be constructed to withstand a minimum of 300 pounds-per-square-inch test pressure without leakage or permanent distortion and shall bear the manufacturer's marking showing test and working pressure, except that such a marking is not required for AGA or UL listed water heater units.

2. *Materials.*

a. Galvanized storage tanks shall be hot-dipped with a coating of not less than 1½ ounces per square foot each side of surface.

b. When water conditions demand, the Chief Underwriter may require monel metal or copper tanks; ferrous tanks lined with glass, cement, or other acceptable lining material; or cathodic protection.

3. *Insulation.* Storage tanks shall be insulated with material having an overall conductance not greater than 0.30 BTU/sf/hr/degree (¾-inch mineral wool or equal). Surface of insulation shall be inherently resistant to or protected from mechanical damage.

CHIMNEY-FLUES AND VENTS

503–A. Separate flues are required for each appliance which depends upon sustained chimney draft for proper operation.

503–B. The chimney shall be of such height, size and construction as to create sufficient draft to develop the rated output of the equipment served and not less than recommended by the equipment manufacturer. In no case shall the height be less than 2 feet above the ridge of the roof that the chimney penetrates and not less than 2 feet above the highest ridge within 10 feet of the chimney.

503–C. Limitations According to Fuel Used.

1. Masonry type Chimneys are acceptable for use with all fuels. For masonry chimneys, see 406–L.

2. Other chimneys, flues or vents may be used if acceptable to the Chief Underwriter for the fuel used.

3. Vents listed or approved by Underwriters' Laboratories only for gas-fired equipment are acceptable for use only with gas as fuel.

a. Installation shall provide clearances according to requirements in Underwriters' Laboratories Approval Report.

b. Provide means to dispose of condensation.

c. Effective area shall be at least equal to area of vent outlet of largest appliance plus at least 50 percent of combined area of vent outlets of all other gas equipment connected to it.

d. Heights at least 1 foot above the roof, not less than 4 feet above the furnace outlet, and the top of the vent at least 4 feet horizontally from any construction that projects upward at an angle greater than 45 degrees with the horizontal.

e. Vent cap shall be designed to prevent downdraft under normal conditions of operation.

f. Maximum length of horizontal vent sections, 75 percent of vertical height of vent or chimney. Pitch up from appliance, minimum, ¼ inch per foot. Support with incombustible material clear of any earth in unexcavated spaces and insulate and protect where necessary.

PLUMBING AND SANITATION REQUIREMENTS

600. Objective. *The objective of plumbing and sanitation requirements is to provide (a) a properly installed system of piping and plumbing fixtures, appropriate to the size and class of dwelling under consideration, supplied with hot and cold water in adequate volume and pressure for cooking, laundering, bathing and toilet purposes; and (b) a water-carriage sewerage system for the safe disposal of wastes from fixtures and installed in a manner to provide healthful and sanitary living conditions.*

GENERAL. *See 401. For Domestic Water Heating and Storage, see 502*

601–A. Codes and Regulations. Comply with the following:

1. State and Local Regulations. Evidence of approval of the plumbing system within the dwelling shall be required when inspection is required by State or local authority. The Chief Underwriter may require plumbing test where not otherwise required.

2. When, in the opinion of the Chief Underwriter, local codes and regulations are inadequate to provide proper sanitary protection, or when no State or local regulations exist, compliance as a minimum shall be obtained with the least restrictive requirement of the following:

a. The "Plumbing Manual" (Report BMS–66) of the National Bureau of Standards, U. S. Department of Commerce; or

b. The "Report of the Coordinating Committee for a National Plumbing Code," U. S. Department of Commerce.

3. Asbestos-cement pipe or bituminized-fiber pipe is acceptable for dry vents from a point 6 inches above the overflow of the highest fixture on a stack.

a. Asbestos-cement pipe shall comply with Federal Specification SS–P–351, with the following substitutions:

(1) Sizes: 1½ inches to 4 inches.
(2) Class: nonpressure tests.
(3) Hydrostatic strength: Not applicable.
(4) Flexural strength: Not applicable.
(5) Crushing strength: Not applicable.

Joints in asbestos-cement pipe shall be made with sleeve couplings of the same composition as the pipe, sealed with rubber rings or leaded.

b. Bituminized-fiber pipe shall comply with Commercial Standard 116 and joints shall be made with tapered type couplings of the same material as the pipe or with an adapter coupling leaded and caulked.

4. Domestic hot water systems shall comply with Section 502.

FIXTURES

602–A. Minimum Fixtures. Each living unit shall contain at least one kitchen sink, one water closet, one lavatory, and one bathtub.

602–B. Installation.

1. All fixtures shall be securely installed.
2. Bathtubs shall be hung on metal supports or end grain of wood blocks secured to the wall construction. See detail 38.

602–C. Bathroom Accessories. A minimum of five accessories including a grab bar shall be installed in each bathroom.

PIPING

603–A. General.

1. Materials shall be new and durable.
2. Size of pipe shall be adequate in relation to fixtures served.
3. All piping shall be installed without damage to structural members. See 408–B–1 and detail 17.
4. All water piping shall be properly sloped and protected against freezing.
5. Metal piping (water, waste, gas or oil lines) shall not be installed in or below cinders, or in other locations which are conducive to rapid corrosive action.
6. Gas service line shall be in a separate trench.
7. Backfill all service trenches with clean earth or clay free of rocks, boulders or debris.

603–B. Supply Lines.

1. Service line shall be laid on solid ground and below frost line. Service line may be laid in same trench with sewer line provided water line is not less than 1 foot higher than the sewer and laid on solid ledge of ground.
2. Cold water lines shall be installed and connected to all fixtures and sill cock, and hot water lines to all fixtures except water closet.
3. Supply lines under concrete slabs shall be installed in a manner to permit repair and replacement unless otherwise acceptable to the Chief Underwriter.
4. Cross-connections between the drinking water supply and supplies not intended for drinking purposes will not be acceptable.
5. Hot and cold water supply lines shall be installed and provided with shut-off and drain valves so that each living unit can be independently controlled within the building. Provide shut-off valve for each water closet.

603–C. Drains.

1. House sewer pipe shall be laid with barrel on solid ground, excavating bell hole for each pipe. Make joints watertight and where necessary protect

against penetration by roots of shrubbery or trees.

2. Drain lines of proper size shall be installed and connected to all fixtures.

3. Cast-iron pipe (or other material acceptable to the Chief Underwriter) shall be installed on all building drainage lines from base of stack to house sewer connection.

4. Cleanouts shall be provided at base of main stack and at all bends in excess of 45°. Cleanouts under concrete slabs on ground subject to acceptance by the Chief Underwriter.

5. Shower stall drains shall be made watertight.

6. Traps subject to freezing shall be protected.

WATER SUPPLY

604–A. General.

1. Each living unit shall be provided with an adequate supply of safe and palatable water connected to the required fixtures.

2. The water shall comply in quality with the requirements of the State Department of Health.

604–B. Source of Water Supply.

1. Wherever available, connection shall be made to a public water system.

2. Where a public system is not available, connection to an approved community system is acceptable.

a. To be acceptable a community system shall comply with all State and local laws and regulations.

b. Evidence shall be submitted showing that the system and the water it provides are considered satisfactory by the State Department of Health.

3. Where neither a public nor an acceptable community system is available, an individual water system is acceptable provided compliance is obtained with the following:

a. All individual water systems shall comply with the Federal Housing Administration "Minimum Requirements for Individual Water-Supply and Sewage-Disposal Systems," for the area in which the property is located.

b. Evidence shall be presented showing that the installation of each individual water supply system is satisfactory to the health authority having jurisdiction. FHA Form 2217 is prepared for this use.

SEWAGE DISPOSAL

605–A. General. Each living unit shall be provided with an adequate and safe method of sewage disposal by a water-carriage system.

605–B. Method of Sewage Disposal.

1. Wherever available, connection shall be made to public sewerage system.

2. Where a public system is not available, connection to an approved community system will be acceptable.

a. To be acceptable a community system shall comply with all State and local laws and regulations.

b. Evidence shall be submitted showing that the system and the method of disposal are considered satisfactory by the State Department of Health.

3. Where neither a public nor acceptable community system is available, an individual sewage-disposal system is acceptable provided compliance is obtained with the following:

a. All individual sewage-disposal systems shall comply with the Federal Housing Administration "Minimum Requirements for Individual Water-Supply and Sewage-Disposal Systems," for the area in which the property is located.

b. Evidence shall be presented showing that the installation of each individual sewage-disposal system is satisfactory to the health authority having jurisdiction. FHA Form 2218 is prepared for this use.

MISCELLANEOUS DRAINAGE. *See also 803.*

606. Dry Wells. Dry wells for the disposal of rain water shall be used only when they are of adequate size and there is reasonable assurance that the soil conditions are favorable for disposal in this manner. When used they shall be located at least 10 feet from basement walls; 20 feet from sewage disposal fields or seepage pits; and 50 feet from wells.

ELECTRICAL REQUIREMENTS

700. Objective. *The objective of electrical requirements is to obtain a system of wiring properly installed to safely provide electric current adequate for efficient illumination and for safe and efficient operation of such appliances and equipment as are considered essential and appropriate to the class of dwelling under consideration.*

GENERAL. *See 401.*

701–A. Facilities for Electrical Service. Electrical service shall be provided for each living unit.

701–B. Codes and Regulations. Installations shall comply with:

1. State and local regulations.
2. National Electrical Code of the National Board of Fire Underwriters when, in the opinion of the Chief Underwriter, local regulations are inadequate to provide proper electrical service.
3. National Electrical Code where no local or State regulations exist.
4. Evidence of compliance with applicable regulations shall be shown whenever required by State or local authority.

MATERIALS

702–A. Materials shall be new and shall conform to standards of Underwriters Laboratories, Inc.

702–B. Reduction in wire size shall not be permitted between appliance or outlet and the distribution panel.

702–C. Metallic electrical conduit shall not be installed in or below cinders, or in other locations which are conducive to rapid corrosive action.

702–D. Minimum Wire Size.

1. Outside service connection, No. 6.
2. Light-duty branch circuits, No. 14.
3. Circuits serving kitchen and laundry, No. 12.
4. Heavy-duty branch circuits, No. 12.
5. Small motors, No. 12.
6. Heaters, No. 10.
7. Ranges, No. 8.

INSTALLATIONS

703–A. Circuits. Install at least one circuit for each 500 square feet of floor area; minimum, three per living unit. Make provision for at least one future circuit.

703–B. Outlets.

1. Ceiling fixtures shall be installed in kitchens, halls, dining roms and bedrooms, unless omission is acceptable to the Chief Underwriter and other acceptable lighting method is provided.

2. In bathrooms, wall fixture and convenience outlet shall be installed at mirror.

3. An outside fixture shall be installed at main entrance and each porch.

4. *Convenience outlets.*

a. Living room shall be provided with one duplex outlet between all doors and between doors and fireplace, when separated sufficiently for placement of furniture.

b. When ceiling fixtures are installed, minimum number:

(1) Dining room or dining space, one duplex outlet.

(2) Each other habitable room, including kitchen, two duplex outlets.

c. In rooms where ceiling fixtures are not required and not installed, minimum number, three duplex outlets.

5. Special purpose outlets shall be installed for each unit of equipment such as electric ranges.

6. Outlets in spaces such as garages, attics, closets and basements shall be subject to the acceptance of the Chief Underwriter.

703–C. Switches.

1. Ceiling fixture or other means of general lighting in habitable rooms and halls shall be controlled by wall switches.

2. When ceiling fixtures or other means of general lighting are not installed at least one outlet per habitable room shall be controlled by a wall switch.

3. Bathroom fixture shall be controlled by a wall switch not readily accessible from tub or shower.

4. For upper floor living units or those occupying more than one floor, provide at least one three-way switch conveniently located on each floor to control at least one light which illuminates the stairs. This shall include basement stairs when garage is built-in on basement level and access is through the basement.

5. Exterior fixtures shall be controlled by wall switches inside the entrance doors.

6. Switches shall not be placed behind doors.

LOT IMPROVEMENT REQUIREMENTS

800. Objective. *The objective of lot improvement requirements is to provide (a) suitable access from the abutting street to the dwelling and accessory buildings; (b) immediate diversion of water away from buildings and, except as necessary for controlled irrigation in arid areas, assured disposal of water from the lot; and (c) an appropriate setting for the dwelling.*

GENERAL. *See 401.*

801–A. *Drainage* of surface water shall be provided away from all sides of all buildings and off the lot in a manner which will prevent soil erosion and standing water and which will minimize the possibility of dampness in basements and crawl spaces; in arid areas, however, controlled ponding for irrigation is permitted if emergency overflows are provided to protect buildings. Walks, driveways, retaining walls and other improvements shall be constructed so as not to interfere with drainage. Required walks shall not be used as drainage channels.

801–B. *Topsoil, desirable trees and other site assets* needed for satisfactory completion of the property shall be protected and preserved during construction operations.

801–C. *Heavy equipment* shall not be used over septic tanks, tile fields, drain lines or other improvements which may be damaged.

ROUGH GRADING

802–A. *Rough grade elevations* shall make proper provision for the subsequent establishment of required subgrade and finish grade elevations for all lot areas and improvements. Allowance shall be made for thickness of topsoil, paving and other installations. See 801, 804, 805, 806, 807.

802–B. *Fill.* All areas to be filled and all materials used for fill shall be free of debris and any material that may disintegrate or be injurious to plant growth. All fills, including backfill around foundations, shall be properly compacted to prevent any settlement which would interfere with storm water drainage or would damage walks, driveway, planting or other improvements.

DRAINAGE STRUCTURES. *See also 406–D–3 and 413–C.*

803–A. *Suitable drainage structures* such as paved gutters, drain inlets and subsurface drain lines shall be installed where determined necessary by the Chief Underwriter to protect against dampness, flooding, erosion

803 – A. Drainage Structures. *Continued.*

or other damage by surface water or ground water. Drainage structures shall be properly connected to adequate outlets which are protected where necessary by recorded permanent easements.

803–B. *Dry wells* for the disposal of storm water shall be used only if they are of adequate size and are in areas of open well-drained soils with high sand and gravel content. If used, they shall be located at least 10 feet from basement walls; 20 feet from sewage disposal fields or seepage pits; and 50 feet from water-supply wells.

DRIVEWAY

804–A. *A driveway* shall be provided from street or alley pavement to the garage or carport, if any; if no garage or carport, a driveway including a 20-foot space shall be provided, generally extending to rear line of dwelling; or in case of unusual difficulty or hardship, other parking space acceptable to the Chief Underwriter shall be provided.

804–B. *Driveway design* shall provide for safe and convenient use:

1. Width shall generally be not less than 8 feet with adequate flare at street or alley for turning.

2. Driveway gradient shall generally be not steeper than required by 805–B for walks if also used as a required walk or, otherwise, not steeper than 1 in 7 (14 percent).

3. Grade transition shall be provided at top and bottom of a steep driveway to prevent undercarriage or bumper guards from dragging.

4. Gradient of a required parking space shall generally be not steeper than 1 in 20 (5 percent).

804–C. *Driveway construction* shall be with suitable subgrade, base, drainage and surfacing to be durable under the use and maintenance contemplated. For concrete, see 406–E.

WALKS AND STEPS

805–A. *A walk and any necessary steps* shall be provided from the house directly to the street pavement or to a driveway connected to the street.

805–B. *Walk design* shall provide for safe and convenient use:

1. Width shall generally be at least 2 feet for service walk and at least 3 feet for front walk.

2. Gradient shall generally be not steeper than 1 in 20 (5 percent) in areas subject to frequent freezing or 1 in 10 (10 percent) in other areas.

3. Cross-slope shall be adequate for immediate drainage of surface water off the walk; required walk shall not be used as a drainage channel.

805–C. *Step design* shall provide for safe and convenient use:

1. Step width shall be not less than the width of the walk that is served.

2. Steps shall generally be not steeper than 6-inch riser and 12-inch tread; in no case shall the riser be more than 7½ inches, the tread less than 11 inches or the sum of riser and tread more than 19 inches or less than 17 inches; step treads shall have at least ⅛-inch pitch for surface drainage; all steps in each flight shall be the same dimensions throughout in riser and tread respectively.

3. A single step in a walk and any flight of steps of more than 5 feet total rise shall be avoided wherever practicable; substantial handrail of durable construction shall be provided if more than 30-inch rise in a single flight.

805–D. *Walk and step construction* shall be of durable and appropriate material, on stable adequately-drained subgrade or bed. For concrete, see 406–E.

FINISH GRADING

806–A. General.

1. All unpaved lot areas, except those preserved in an appropriate natural condition, shall be fine graded to provide smooth even surfaces conforming to elevations required below.

2. Topsoil of adequate quality and depth to support plant growth shall be provided at least on required lawn and planting areas.

3. All debris shall be removed from subgrade, topsoil, and finished surface.

806–B. *Minimum Protective Slopes.*
Protective slopes away from all walls and foundations of buildings and any water-supply well shall be provided to assure immediate drainage and diversion of surface water away from these structures. Protective slopes, when measured along a line perpendicular to the structure at any point along a wall or foundation, shall have a continuous downward slope with a minimum gradient of 6 inches in 25 feet (2 percent), a vertical fall of at least 6 inches, and a horizontal length of at least 10 feet, except that if restricted by side lot lines or other major considerations the horizontal length of such slopes may be reduced as necessary at building corners and side yards. For floor elevation in relation to finish grade elevations see 403–B and 406–F–1.

806–C. *Minimum slopes of other unpaved areas* shall be at least 6 inches in 25 feet (2 percent) in areas subject to ground frost, at least 3 inches in 25 feet (1 percent) in other areas, or in case of unusual difficulty or hardship, not less than the minimum gradient determined by the Chief Under-

806 – C. Finish Grading. *Continued.*

writer as adequate to prevent at all seasons any prolonged saturation of soil or standing water. If required minimum slopes cannot be attained by other means, paved gutters or other drainage structures shall be installed as acceptable to the Chief Underwriter. In arid areas minimum slopes are not required where the lot is provided with controlled ponding for irrigation and with emergency overflows which protect buildings.

806–D. *Storm Water Disposal.*

1. All unpaved areas shall slope continuously at the required gradients to lower elevations off the lot or to drainage structures on the lot.

2. Drainage swales or valleys formed by intersecting slopes shall have adequate depth, width and longitudinal gradient to carry away the maximum predictable volume of storm water runoff. Gradients of unpaved swales shall be not less than that required above for other unpaved areas.

3. Where catch basins or inlets are installed, other than at required basement areaways, the finish grade elevations of adjoining areas shall provide for emergency surface overflow so that, in the event of failure of catch basins or inlets, the buildings and wells will be protected against flooding.

4. Areaways for basement windows, entrances, and garage entrances shall be provided with effective drainage facilities. Catchment area shall be as small as possible and shall be protected from overflow of stormwater from adjacent areas.

806–E. *Maximum Slopes.*

1. The maximum height and steepness of slopes and maximum gradients of unpaved drainage channels shall be such as can be satisfactorily maintained without erosion or land slides and will provide adequate usable yard areas and satisfactory access to and around buildings.

2. Usable rear yard area shall generally be at least 15 feet deep with gradient not steeper than 1 in 20 (5 percent).

3. Usable yard area on other sides of buildings shall be provided as necessary for any required planting, for access around the buildings and for maintenance of building and lot improvements, generally at least 4 feet wide with gradient away from building not steeper than 1 in 10 (10 percent).

4. Where considered necessary by the Chief Underwriter, precautionary measures shall be taken such as retaining walls, sodding or planting to stabilize the soil.

LAWN AND PLANTING

807–A. *Lawn seeding, sodding or sprigging* shall be done to the extent determined necessary by the Chief Underwriter to prevent soil erosion and provide usable yard areas, and in such manner that a thick stand of permanent grass will be established. Steep banks and drainage swales generally shall be sodded.

807–B. *Trees, shrubs and vines* shall be planted in quantities and sizes determined necessary by the Chief Underwriter to assure adequate screening of any objectionable views and timely provision of summer shade and a suitable setting for the dwelling. Plant material shall be appropriate for its location and use and shall be installed in such manner that it will thrive with reasonable maintenance.

APPENDIX A

TABLES OF MAXIMUM ALLOWABLE SPANS for Wood Floor Joists, Ceiling Joists and Rafters

Included herein are the species of framing lumber most frequently used in the area under the jurisdiction of this office. Allowable spans for other species of lumber may be obtained from the FHA office.

INDEX

Douglas Fir:	
Coast Region	**A – 2**
Rocky Mountain Region	**A – 5**
Fir, White	**A – 8**
Pine, Eastern White	**A – 10**
Pine, Southern Yellow	**A – 12**
Redcedar, Western	**A – 15**
Redwood	**A – 18**
Rafter Span, Conversion Diagram	**A – 21**

DOUGLAS FIR

Coast Region

Table I.—FLOOR JOISTS

DRESSED LUMBER, Includes S4S and S2E

Nominal size (inches)	Spacing c. to c.	1900-f Select Structural Framing etc.	No. 1 Framing, Joists, Plank	No. 2 Framing, Joists, Plank	No. 3 Framing, Joists, Plank
	In.	*Ft. In.*	*Ft. In.*	*Ft. In.*	*Ft. In.*
2 x 6	12	11 3	11 3	11 3	7 7
	16	10 2	10 2	10 2	6 7
	20	9 6	9 6	9 2	5 10
	24	8 11	8 11	8 4	5 4
2 x 8	12	15 0	15 0	15 0	11 8
	16	13 8	13 8	13 8	10 1
	20	12 8	12 8	12 2	9 0
	24	11 11	11 11	11 2	8 3
3 x 8	12	17 8	17 8	17 8	14 10
	16	16 0	16 0	16 0	12 10
	20	14 11	14 11	14 11	11 6
	24	14 0	14 0	14 0	10 6
2 x 10	12	19 0	19 0	19 0	15 11
	16	17 3	17 3	17 3	13 9
	20	16 1	16 1	15 5	12 4
	24	15 1	15 1	14 1	11 3
3 x 10	12	22 4	22 4	22 4	20 1
	16	20 3	20 3	20 3	17 6
	20	18 10	18 10	18 10	15 8
	24	17 9	17 9	17 9	14 4
2 x 12	12	23 0	23 0	23 0	18 7
	16	20 10	20 10	20 10	16 1
	20	19 5	19 5	18 8	14 5
	24	18 3	18 3	17 1	13 2
ROUGH LUMBER					
2 x 6	12	12 10	12 10	12 10	8 11
	16	11 8	11 8	11 8	7 9
	20	10 10	10 10	10 10	6 11
	24	10 3	10 3	9 11	6 4
2 x 8	12	17 2	17 2	17 2	13 10
	16	15 7	15 7	15 7	11 11
	20	14 6	14 6	14 5	10 8
	24	13 7	13 7	13 2	9 9
3 x 8	12	19 8	19 8	19 8	16 11
	16	17 10	17 10	17 10	14 7
	20	16 7	16 7	16 7	13 1
	24	15 7	15 7	15 7	11 11
2 x 10	12	21 6	21 6	21 6	18 7
	16	19 6	19 6	19 6	16 1
	20	18 1	18 1	18 1	14 5
	24	17 1	17 1	16 6	13 2
3 x 10	12	24 7	24 7	24 7	22 10
	16	22 4	22 4	22 4	19 8
	20	20 8	20 8	20 8	17 8
	24	19 6	19 6	19 6	16 2
2 x 12	12	25 9	25 9	25 9	21 6
	16	23 5	23 5	23 5	18 8
	20	21 8	21 8	21 8	16 8
	24	20 5	20 5	19 10	15 2

DOUGLAS FIR

Coast Region

Table II.—FLAT ROOF JOISTS

DRESSED LUMBER, Includes S4S and S2E

Nominal size (inches)	Spacing c. to c.	1900–f Select Structural Framing etc.		No. 1 Framing, Joists, Plank		No. 2 Framing, Joists, Plank		No. 3 Framing, Joists, Plank	
Supporting finished ceiling									
	In.	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*
2 x 6	12	14	2	14	2	12	7	8	0
	16	12	10	12	6	10	10	6	11
	20	12	0	11	2	9	8	6	2
	24	11	3	10	2	8	10	5	8
2 x 8	12	18	11	18	11	16	8	12	4
	16	17	2	16	8	14	6	10	8
	20	16	0	14	11	13	0	9	7
	24	15	0	13	7	11	10	8	9
3 x 8	12	22	2	22	2	21	3	15	8
	16	20	2	20	2	18	5	13	7
	20	18	9	18	9	16	6	12	2
	24	17	7	17	3	15	1	11	1
2 x 10	12	23	11	23	11	21	2	16	11
	16	21	8	21	0	18	4	14	7
	20	20	3	18	10	16	5	13	1
	24	19	0	17	2	15	0	11	11
3 x 10	12	28	2	28	2	26	11	21	5
	16	25	7	25	7	23	3	18	7
	20	23	9	23	9	20	10	16	7
	24	22	4	21	10	19	0	15	2
2 x 12	12	29	0	29	0	25	8	19	8
	16	26	4	25	6	22	2	17	1
	20	24	6	22	10	19	10	15	3
	24	23	0	20	10	18	2	13	10
Not supporting finished ceiling									
	In.	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*
2 x 6	12	14	2	14	2	14	2	9	3
	16	12	10	12	10	12	7	8	0
	20	12	0	12	0	11	3	7	2
	24	11	3	11	3	10	3	6	7
2 x 8	12	18	11	18	11	18	11	14	3
	16	17	2	17	2	16	9	12	4
	20	16	0	16	0	15	0	11	0
	24	15	0	15	0	13	8	10	1
3 x 8	12	22	2	22	2	22	2	18	1
	16	20	2	20	2	20	2	15	8
	20	18	9	18	9	18	9	14	1
	24	17	7	17	7	17	4	12	10
2 x 10	12	23	11	23	11	23	11	19	6
	16	21	8	21	8	21	3	16	10
	20	20	3	20	3	19	0	15	1
	24	19	0	19	0	17	4	13	10
3 x 10	12	28	2	28	2	28	2	24	10
	16	25	7	25	7	25	7	21	5
	20	23	9	23	9	23	9	19	2
	24	22	4	22	4	22	0	17	6
2 x 12	12	29	0	29	0	29	0	22	9
	16	26	4	26	4	25	8	19	9
	20	24	6	24	6	23	0	17	8
	24	23	0	23	0	21	0	16	1
ROUGH LUMBER									
2 x 6	12	16	2	16	2	14	10	9	6
	16	14	9	14	9	12	10	8	3
	20	13	8	13	2	11	6	7	4
	24	12	11	12	2	10	7	6	9
2 x 8	12	21	8	21	8	19	9	14	7
	16	19	7	19	7	17	1	12	8
	20	18	3	17	7	15	4	11	4
	24	17	2	16	1	14	0	10	4
3 x 8	12	24	10	24	10	24	2	17	11
	16	22	5	22	5	21	0	15	6
	20	20	10	20	10	18	9	13	10
	24	19	8	19	8	17	2	12	8
2 x 10	12	27	0	27	0	24	9	19	9
	16	24	7	24	7	21	5	17	1
	20	22	10	22	0	19	2	15	3
	24	21	5	20	1	17	6	13	11
3 x 10	12	31	0	31	0	30	3	24	2
	16	28	1	28	1	26	2	20	11
	20	26	2	26	2	23	5	18	8
	24	24	7	24	7	21	5	17	1
2 x 12	12	32	5	32	5	29	8	22	10
	16	29	6	29	6	25	8	19	9
	20	27	5	26	5	23	0	17	8
	24	25	10	24	1	21	0	16	2
Not supporting finished ceiling									
	In.	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*
2 x 6	12	16	2	16	2	16	2	11	0
	16	14	9	14	9	14	9	9	6
	20	13	8	13	8	13	3	8	6
	24	12	11	12	11	12	1	7	9
2 x 8	12	21	8	21	8	21	8	16	10
	16	19	7	19	7	19	7	14	7
	20	18	3	18	3	17	8	13	1
	24	17	2	17	2	16	2	11	11
3 x 8	12	24	10	24	10	24	10	20	8
	16	22	5	22	5	22	5	17	11
	20	20	10	20	10	20	10	16	0
	24	19	8	19	8	19	8	14	7
2 x 10	12	27	0	27	0	27	0	22	10
	16	24	7	24	7	24	7	19	9
	20	22	10	22	10	22	2	17	8
	24	21	5	21	5	20	2	16	1
3 x 10	12	31	0	31	0	31	0	27	10
	16	28	1	28	1	28	1	24	2
	20	26	2	26	2	26	2	21	7
	24	24	7	24	7	24	7	19	9
2 x 12	12	32	5	32	5	32	5	26	4
	16	29	6	29	6	29	6	22	10
	20	27	5	27	5	26	6	20	5
	24	25	10	25	10	24	2	18	7

DOUGLAS FIR

Coast Region

Table III.—CEILING JOISTS

Limited Attic Storage										No Attic Storage									
Nominal size (inches)	Spacing c. to c.	1900–f Select Structural Framing etc.		No. 1 Framing, Joists, Plank		No. 2 Framing, Joists, Plank		No. 3 Framing, Joists, Plank		Nominal size (inches)	Spacing c. to c.	1900–f Select Structural Framing etc.		No. 1 Framing, Joists, Plank		No. 2 Framing, Joists, Plank		No. 3 Framing, Joists, Plank	
	In.	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*		*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*
2 x 4*	12	9	2	8	2	6	4	4	1	2 x 4*	12	11	6	11	6	10	11	7	1
	16	8	3	7	1	5	5	3	6		16	10	6	10	6	9	5	6	2
	20	7	9	6	4	4	10	3	2		20	9	8	9	8	8	5	5	6
	24	7	3	5	10	4	5	2	11		24	9	1	9	1	7	8	5	0
2 x 6	12	14	2	14	2	14	2	9	3	2 x 6	12	17	10	17	10	17	10	16	1
	16	12	10	12	10	12	7	8	0		16	16	5	16	5	16	5	13	11
	20	12	0	12	0	11	3	7	2		20	15	0	15	0	15	0	12	5
	24	11	3	11	3	10	3	6	7		24	14	2	14	2	14	2	11	4
2 x 8	12	18	11	18	11	18	11	14	3	2 x 8	12	23	10	23	10	23	10	22	10
	16	17	1	17	1	16	9	12	4		16	21	10	21	10	21	10	20	11
	20	16	0	16	0	15	0	11	0		20	20	0	20	0	20	0	19	1
	24	15	0	15	0	13	8	10	1		24	18	11	18	11	18	11	17	6
2 x 10	12	23	11	23	11	23	11	19	6	2 x 10	12	--	--	--	--	--	--	--	--
	16	21	8	21	8	21	3	16	10		16	--	--	--	--	--	--	--	--
	20	20	3	20	3	19	0	15	1		20	--	--	--	--	--	--	--	--
	24	19	0	19	0	17	4	13	10		24	--	--	--	--	--	--	--	--

* No. 1 and No. 2, studding and blocking grades.

Table IV.—RAFTERS

[Roof slopes greater than 3 in 12. Span is the actual length of the rafter between the plate and the ridge or an intermediate support]

Nominal size (inches)	Spacing c. to c.	1900–f Select Structural Framing, etc.				No. 1 Framing, Joists, Plank, etc.				No. 2 Framing, Joists, Plank, etc.				No. 3 Framing, Joists, Plank, etc.			
		Light roofing		Heavy roofing		Light roofing		Heavy roofing		Light roofing		Heavy roofing		Light roofing		Heavy roofing	
	In.	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*
2 x 4*	12	15	4	13	8	10	4	9	2	7	11	7	0	5	2	4	7
	16	13	4	11	11	8	11	7	11	6	10	6	1	4	5	3	11
	20	11	11	10	8	8	0	7	1	6	2	5	5	4	0	3	6
	24	10	11	9	9	7	4	6	6	5	7	5	0	3	7	3	3
2 x 6	12	23	10	21	3	20	10	18	7	18	2	16	2	11	8	10	4
	16	20	7	18	5	18	1	16	1	15	9	14	0	10	1	9	0
	20	18	7	16	4	16	2	14	5	14	1	12	6	9	0	8	0
	24	16	11	15	0	14	9	13	2	12	11	11	5	8	3	7	4
2 x 8	12	31	11	28	5	27	10	24	10	24	3	21	7	17	11	16	0
	16	27	7	24	7	24	2	21	5	21	0	18	8	15	6	13	10
	20	24	7	22	0	21	7	19	2	18	10	16	9	13	11	12	4
	24	22	6	20	0	19	8	17	6	17	2	15	3	12	8	11	3
2 x 10	12	40	5	35	11	35	3	31	5	30	8	27	4	24	6	21	10
	16	34	10	31	1	30	6	27	2	26	7	23	8	21	2	18	11
	20	31	3	27	10	27	3	24	4	23	9	21	2	19	0	16	11
	24	28	6	25	5	24	11	22	2	21	8	19	4	17	4	15	5

* No. 1 and No. 2, studding and blocking grades.
Light Roofing: Material weighing, in place, 5 pounds or less per square foot.
Heavy Roofing: Material weighing, in place, over 5 pounds per square foot.

DOUGLAS FIR

Rocky Mt. Region

Table I—FLOOR JOISTS

DRESSED LUMBER, Includes S4S and S2E

Nominal size (inches)	Spacing c. to c.	Structural joists and plank	Common structural joists and plank	No. 1 Dimension	No. 2 Dimension
	In.	*Ft. In.*	*Ft. In.*	*Ft. In.*	*Ft. In.*
2 x 6	12	10 3	10 3	10 1	7 2
	16	9 4	9 4	8 9	6 2
	20	8 8	8 8	7 10	5 6
	24	8 1	8 1	7 2	5 0
2 x 8	12	13 8	13 8	13 8	10 7
	16	12 5	12 5	12 0	9 3
	20	11 6	11 6	10 9	8 3
	24	10 10	10 10	9 10	7 6
3 x 8	12	16 0	16 0	16 0	13 6
	16	14 7	14 7	14 7	11 8
	20	13 7	13 7	13 7	10 6
	24	12 9	12 9	12 6	9 7
2 x 10	12	17 3	17 3	17 3	14 9
	16	15 8	15 8	15 8	12 9
	20	14 7	14 7	14 5	11 5
	24	13 9	13 9	13 1	10 5
3 x 10	12	20 2	20 2	20 2	18 9
	16	18 5	18 5	18 5	16 2
	20	17 2	17 2	17 2	14 6
	24	16 1	16 1	16 1	13 3
2 x 12	12	20 10	20 10	20 10	18 7
	16	19 0	19 0	19 0	16 1
	20	17 8	17 8	17 8	14 5
	24	16 7	16 7	16 7	13 2

ROUGH LUMBER

2 x 6	12	11 8	11 8	11 8	8 5
	16	10 8	10 8	10 4	7 4
	20	9 11	9 11	9 3	6 6
	24	9 4	9 4	8 5	6 0
2 x 8	12	15 7	15 7	15 7	12 7
	16	14 2	14 2	14 2	10 11
	20	13 2	13 2	12 9	9 9
	24	12 5	12 5	11 7	8 11
3 x 8	12	17 10	17 10	17 10	15 5
	16	16 3	16 3	16 3	13 4
	20	15 1	15 1	15 1	11 11
	24	14 2	14 2	14 2	10 11
2 x 10	12	19 6	19 6	19 6	17 2
	16	17 7	17 7	17 7	14 11
	20	16 5	16 5	16 5	13 4
	24	15 6	15 6	15 4	12 2
3 x 10	12	22 4	22 4	22 4	21 1
	16	20 3	20 3	20 3	18 3
	20	18 10	18 10	18 10	16 4
	24	17 9	17 9	17 9	14 11
2 x 12	12	23 5	23 5	23 5	21 6
	16	21 2	21 2	21 2	18 8
	20	19 9	19 9	19 9	16 8
	24	18 7	18 7	18 7	15 2

DOUGLAS FIR

Rocky Mt. Region

Table II—FLAT ROOF JOISTS

DRESSED LUMBER, Includes S4S and S2E

Supporting finished ceiling									Not supporting finished ceiling								
Nominal size (inches)	Spacing c. to c.	Structural joists and plank		Common structural joists and plank		No. 1 Dimension		No. 2 Dimension		Nominal size (inches)	Spacing c. to c.	Structural joists and plank		Common structural joists and plank		No. 1 Dimension		No. 2 Dimension	
	In.	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*		*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*
2 x 6	12	12	11	12	7	10	8	7	7	2 x 6	12	12	11	12	11	12	4	8	9
	16	11	9	10	10	9	3	6	6		16	11	9	11	9	10	8	7	7
	20	10	11	9	8	8	3	5	10		20	10	11	10	11	9	7	6	9
	24	10	2	8	10	7	7	5	4		24	10	3	10	3	8	9	6	2
2 x 8	12	17	2	16	8	14	8	11	3	2 x 8	12	17	2	17	2	17	0	13	0
	16	15	7	14	6	12	9	9	9		16	15	7	15	7	14	8	11	3
	20	14	6	13	0	11	5	8	9		20	14	6	14	6	13	2	10	1
	24	13	7	11	10	10	4	7	11		24	13	8	13	8	12	0	9	3
3 x 8	12	20	2	20	2	18	8	14	4	3 x 8	12	20	2	20	2	20	2	16	6
	16	18	4	18	4	16	2	12	5		16	18	4	18	4	18	4	14	4
	20	17	0	16	6	14	6	11	1		20	17	0	17	0	16	9	12	10
	24	16	0	15	1	13	3	10	2		24	16	0	16	0	15	3	11	8
2 x 10	12	21	9	21	2	19	8	15	8	2 x 10	12	21	9	21	9	21	9	18	1
	16	19	10	18	4	17	0	13	6		16	19	10	19	10	19	8	15	7
	20	18	5	16	5	15	3	12	1		20	18	5	18	5	17	7	14	0
	24	17	2	15	0	13	11	11	1		24	17	4	17	4	16	1	12	9
3 x 10	12	25	7	25	7	25	0	19	10	3 x 10	12	25	7	25	7	25	7	22	11
	16	23	2	23	2	21	7	17	2		16	23	2	23	2	23	2	19	10
	20	21	7	20	10	19	4	15	5		20	21	7	21	7	21	7	17	10
	24	20	3	19	0	17	8	14	1		24	20	3	20	3	20	3	16	3
2 x 12	12	26	4	25	8	25	0	19	8	2 x 12	12	26	4	26	4	26	4	22	9
	16	24	0	22	2	21	8	17	1		16	24	0	24	0	24	0	19	9
	20	22	3	19	10	19	5	15	3		20	22	3	22	3	22	3	17	8
	24	20	10	18	2	17	9	13	10		24	20	10	20	10	20	6	16	1

ROUGH LUMBER

2 x 6	12	14	9	14	9	12	8	8	11	2 x 6	12	14	9	14	9	14	7	10	4
	16	13	5	12	10	11	0	7	9		16	13	5	13	5	12	8	8	11
	20	12	6	11	6	9	10	6	11		20	12	6	12	6	11	4	8	0
	24	11	8	10	7	9	0	6	5		24	11	8	11	8	10	4	7	4
2 x 8	12	19	7	19	7	17	5	13	4	2 x 8	12	19	7	19	7	19	7	15	5
	16	17	10	17	1	15	1	11	6		16	17	10	17	10	17	5	13	4
	20	16	7	15	4	13	6	10	4		20	16	7	16	7	15	6	11	11
	24	15	7	14	0	12	4	9	5		24	15	7	15	7	14	2	10	11
3 x 8	12	22	5	22	5	21	3	16	4	3 x 8	12	22	5	22	5	22	5	18	10
	16	20	5	20	5	18	5	14	2		16	20	5	20	5	20	5	16	4
	20	19	0	18	9	16	6	12	8		20	19	0	19	0	19	0	14	7
	24	17	10	17	2	15	1	11	7		24	17	10	17	10	17	5	13	4
2 x 10	12	24	7	24	7	23	0	18	3	2 x 10	12	24	7	24	7	24	7	21	1
	16	22	4	21	5	19	10	15	10		16	22	4	22	4	22	4	18	4
	20	20	9	19	2	17	10	14	2		20	20	9	20	9	20	7	16	4
	24	19	6	17	6	16	3	12	11		24	19	6	19	6	18	9	14	11
3 x 10	12	28	2	28	2	28	2	22	5	3 x 10	12	28	2	28	2	28	2	25	10
	16	25	7	25	7	24	4	19	4		16	25	7	25	7	25	7	22	4
	20	23	8	23	5	21	10	17	4		20	23	8	23	8	23	8	20	0
	24	22	4	21	5	19	11	15	10		24	22	4	22	4	22	4	18	3
2 x 12	12	29	6	29	6	29	0	22	10	2 x 12	12	29	6	29	6	29	6	26	4
	16	26	10	25	8	25	1	19	9		16	26	10	26	10	26	10	22	10
	20	24	10	23	0	22	5	17	8		20	24	10	24	10	24	10	20	5
	24	23	5	21	0	20	6	16	2		24	23	5	23	5	23	5	18	7

DOUGLAS FIR

Rocky Mt. Region

Table III.—CEILING JOISTS

Limited Attic Storage									No Attic Storage								
Nominal size (inches)	Spacing c. to c.	Structural joists and plank		Common structural joists and plank		No. 1 Dimension		No. 2 Dimension	Nominal size (inches)	Spacing c. to c.	Srructural joists and plank		Common structural joists and plank		No. 1 Dimension		No. 2 Dimension	
	In.	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.* *In.*		*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*
2 x 4	12	8	4	8	4	7	2	3 9	2 x 4	12	10	5	10	5	10	5	6	6
	16	7	6	7	6	6	2	3 3		16	9	6	9	6	9	6	5	8
	20	7	0	7	0	5	7	2 11		20	8	10	8	10	8	10	5	1
	24	6	7	6	7	5	1	2 8		24	8	4	8	4	8	4	4	8
2 x 6	12	12	11	12	11	12	4	8 9	2 x 6	12	16	3	16	3	16	3	15	1
	16	11	8	11	8	10	8	7 7		16	14	11	14	11	14	11	13	1
	20	10	11	10	11	9	7	6 9		20	13	7	13	7	13	7	11	8
	24	10	3	10	3	8	9	6 2		24	12	11	12	11	12	11	10	8
2 x 8	12	17	2	17	2	17	0	13 0	2 x 8	12	21	7	21	7	21	7	21	7
	16	15	7	15	7	14	8	11 3		16	19	10	19	10	19	10	19	7
	20	14	7	14	7	13	2	10 1		20	18	1	18	1	18	1	17	6
	24	13	8	13	8	12	0	9 3		24	17	2	17	2	17	2	16	0
2 x 10	12	21	9	21	9	21	9	18 1	2 x 10	12	--	--	--	--	--	--	--	--
	16	19	8	19	8	19	8	15 7		16	--	--	--	--	--	--	--	--
	20	18	5	18	5	17	7	14 0		20	--	--	--	--	--	--	--	--
	24	17	3	17	3	16	1	12 9		24	--	--	--	--	--	--	--	--

Table IV.—RAFTERS

Roof slopes greater than 3 in 12. Span is the actual length of the rafter between the plate and the ridge or an intermediate support]

Nominal size (inches)	Spacing c. to c.	Structural joists and plank				Common structural joists and plank				No. 1 Dimension				No. 2 Dimension			
		Light roofing		Heavy roofing		Light roofing		Heavy roofing		Light roofing		Heavy roofing		Light roofing		Heavy roofing	
	In.	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*
2 x 4	12	13	6	12	0	11	9	10	5	9	0	8	0	4	9	4	3
	16	11	8	10	4	10	2	9	0	7	10	6	11	4	1	3	8
	20	10	5	9	3	9	1	8	1	7	0	6	2	3	8	3	3
	24	9	6	8	6	8	4	7	4	6	4	5	8	3	4	3	0
2 x 6	12	20	10	18	7	18	2	16	2	15	6	13	10	11	0	9	9
	16	18	1	16	1	15	9	14	0	13	5	11	11	9	6	8	5
	20	16	2	14	5	14	1	12	6	12	0	10	8	8	6	7	7
	24	14	9	13	2	12	11	11	5	11	0	9	9	7	9	6	11
2 x 8	12	27	10	24	10	24	3	21	7	21	4	19	0	16	4	14	7
	16	24	2	21	5	21	0	18	8	18	6	16	5	14	2	12	7
	20	21	7	19	2	18	10	16	9	16	6	14	8	12	8	11	3
	24	19	8	17	6	17	2	15	3	15	1	13	5	11	7	10	4
2 x 10	12	35	3	31	5	30	8	27	4	28	6	25	5	22	8	20	2
	16	30	6	27	2	26	7	23	8	24	8	22	0	19	8	17	6
	20	27	3	24	4	23	9	21	2	22	1	19	8	17	7	15	7
	24	24	11	22	2	21	8	19	4	20	2	18	0	16	0	14	3

Light Roofing: Material weighing, in place, 5 pounds or less per square foot.
Heavy Roofing: Material weighing, in place, over 5 pounds per square foot.

FIR, WHITE

Table I.—FLOOR JOISTS

DRESSED LUMBER, Includes S4S and S2E

Nominal size (inches)	Spacing c. to c.	No. 1 Dimension	No. 2 Dimension	Nominal size (inches)	Spacing c. to c.	No. 1 Dimension	No. 2 Dimension
	In.	*Ft. In.*	*Ft. In.*		*In.*	*Ft. In.*	*Ft. In.*
2 x 6	12	9 11	7 2	2 x 10	12	16 9	14 9
	16	8 9	6 2		16	15 2	12 9
	20	7 10	5 6		20	14 2	11 5
	24	7 2	5 0		24	13 1	10 5
2 x 8	12	13 3	10 7	3 x 10	12	19 8	18 9
	16	12 0	9 3		16	17 10	16 2
	20	10 9	8 3		20	16 8	14 6
	24	9 10	7 6		24	15 8	13 3
3 x 8	12	15 7	13 6	2 x 12	12	20 3	18 7
	16	14 2	11 8		16	18 5	16 1
	20	13 2	10 6		20	17 2	14 5
	24	12 4	9 7		24	16 1	13 2
ROUGH LUMBER							
2 x 6	12	11 5	8 5	2 x 10	12	18 11	17 2
	16	10 4	7 4		16	17 2	14 11
	20	9 3	6 6		20	16 0	13 4
	24	8 5	6 0		24	15 0	12 2
2 x 8	12	15 2	12 7	3 x 10	12	21 8	21 1
	16	13 9	10 11		16	19 9	18 3
	20	12 9	9 9		20	18 3	16 4
	24	11 7	8 11		24	17 2	14 11
3 x 8	12	17 4	15 5	2 x 12	12	22 9	21 6
	16	15 9	13 4		16	20 7	18 8
	20	14 8	11 11		20	19 2	16 8
	24	13 9	10 11		24	18 0	15 2

Table II.—FLAT ROOF JOISTS

DRESSED LUMBER, Includes S4S and S2E

Nominal size (inches)	Spacing c. to c.	Supporting finished ceiling: No. 1 Dimension	Supporting finished ceiling: No. 2 Dimension	Not supporting finished ceiling: No. 1 Dimension	Not supporting finished ceiling: No. 2 Dimension	Nominal size (inches)	Spacing c. to c.	Supporting finished ceiling: No. 1 Dimension	Supporting finished ceiling: No. 2 Dimension	Not supporting finished ceiling: No. 1 Dimension	Not supporting finished ceiling: No. 2 Dimension
	In.	*Ft. In.*	*Ft. In.*	*Ft. In.*	*Ft. In.*		*In.*	*Ft. In.*	*Ft. In.*	*Ft. In.*	*Ft. In.*
2 x 6	12	10 8	7 7	12 4	8 9	2 x 10	12	19 8	15 8	21 2	18 1
	16	9 3	6 6	10 8	7 7		16	17 0	13 6	19 3	15 7
	20	8 3	5 10	9 7	6 9		20	15 3	12 1	17 7	14 0
	24	7 7	5 4	8 9	6 2		24	13 11	11 1	16 1	12 9
2 x 8	12	14 8	11 3	16 8	13 0	3 x 10	12	25 0	19 10	24 10	22 11
	16	12 9	9 9	14 8	11 3		16	21 7	17 2	22 6	19 10
	20	11 5	8 9	13 2	10 1		20	19 4	15 5	21 0	17 10
	24	10 4	7 11	12 0	9 3		24	17 8	14 1	19 9	16 3
3 x 8	12	18 8	14 4	19 7	16 6	2 x 12	12	25 0	19 8	25 7	22 9
	16	16 2	12 5	17 10	14 4		16	21 8	17 1	23 3	19 9
	20	14 6	11 1	16 7	12 10		20	19 5	15 3	21 7	17 8
	24	13 3	10 2	15 3	11 8		24	17 9	13 10	20 4	16 1
ROUGH LUMBER											
2 x 6	12	12 8	8 11	14 4	10 4	2 x 10	12	23 0	18 3	23 10	21 1
	16	11 0	7 9	12 8	8 11		16	19 10	15 10	21 8	18 4
	20	9 10	6 11	11 4	8 0		20	17 10	14 2	20 1	16 4
	24	9 0	6 5	10 4	7 4		24	16 3	12 11	18 9	14 11
2 x 8	12	17 5	13 4	19 1	15 5	3 x 10	12	27 4	22 5	27 4	25 10
	16	15 1	11 6	17 4	13 4		16	24 4	19 4	24 10	22 4
	20	13 6	10 4	15 6	11 11		20	21 10	17 4	23 0	20 0
	24	12 4	9 5	14 2	10 11		24	19 11	15 10	21 8	18 3
3 x 8	12	21 3	16 4	21 10	18 10	2 x 12	12	28 8	22 10	28 8	26 4
	16	18 5	14 2	19 10	16 4		16	25 1	19 9	26 0	22 10
	20	16 6	12 8	18 5	14 7		20	22 5	17 8	24 2	20 5
	24	15 1	11 7	17 4	13 4		24	20 6	16 2	22 9	18 7

FIR, WHITE

Table III.—CEILING JOISTS

Limited Attic Storage				No Attic Storage			
Nominal size (inches)	Spacing c. to c.	No. 1 Dimension	No. 2 Dimension	Nominal size (inches)	Spacing c. to c.	No. 1 Dimension	No. 2 Dimension
	In.	*Ft. In.*	*Ft. In.*		*In.*	*Ft. In.*	*Ft. In.*
2 x 4	12	7 2	3 9	2 x 4	12	10 2	6 6
	16	6 2	3 3		16	9 3	5 8
	20	5 7	2 11		20	8 6	5 1
	24	5 1	2 8		24	8 1	4 8
2 x 6	12	12 4	8 9	2 x 6	12	15 9	15 1
	16	10 8	7 7		16	14 6	13 1
	20	9 7	6 9		20	13 3	11 8
	24	8 9	6 2		24	12 6	10 8
2 x 8	12	16 8	13 0	2 x 8	12	21 1	21 1
	16	14 8	11 3		16	19 3	19 3
	20	13 2	10 1		20	17 7	17 6
	24	12 0	9 3		24	16 8	16 0
2 x 10	12	21 1	18 1	2 x 10	12	-- --	-- --
	16	19 2	15 7		16	-- --	-- --
	20	17 7	14 0		20	-- --	-- --
	24	16 1	12 9		24	-- --	-- --

Table IV.—RAFTERS

[Roof slopes greater than 3 in 12. Span is the actual length of the rafter between the plate and the ridge or an intermediate support]

Nominal size (inches)	Spacing c. to c.	No. 1 Dimension		No. 2 Dimension	
		Light roofing	Heavy roofing	Light roofing	Heavy roofing
	In.	*Ft. In.*	*Ft. In.*	*Ft. In.*	*Ft. In.*
2 x 4	12	9 0	8 0	4 9	4 3
	16	7 10	6 11	4 1	3 8
	20	7 0	6 2	3 8	3 3
	24	6 4	5 8	3 4	3 0
2 x 6	12	15 6	13 10	11 0	9 9
	16	13 5	11 11	9 6	8 5
	20	12 0	10 8	8 6	7 7
	24	11 0	9 9	7 9	6 11
2 x 8	12	21 4	19 0	16 4	14 7
	16	18 6	16 5	14 2	12 7
	20	16 6	14 8	12 8	11 3
	24	15 1	13 5	11 7	10 4
2 x 10	12	28 6	25 5	22 8	20 2
	16	24 8	22 0	19 8	17 6
	20	22 1	19 8	17 7	15 7
	24	20 2	18 0	16 0	14 3

Light Roofing: Material weighing, in place, 5 pounds or less per square foot.
Heavy Roofing: Material weighing, in place, over 5 pounds per square foot.

PINE, EASTERN WHITE

Table I.—FLOOR JOISTS

DRESSED LUMBER. Includes S4S and S2E

Nominal size (inches)	Spacing c. to c.	No. 1 Dimension	Nominal size (inches)	Spacing c. to c.	No. 1 Dimension
	In.	*Ft. In.*		*In.*	*Ft. In.*
2 x 6	12	9 1	2 x 10	12	16 3
	16	7 10		16	14 9
	20	7 0		20	13 2
	24	6 5		24	12 0
2 x 8	12	12 7	3 x 10	12	19 0
	16	10 11		16	17 4
	20	9 9		20	16 1
	24	8 11		24	15 2
3 x 8	12	15 1	2 x 12	12	19 9
	16	13 8		16	17 10
	20	12 5		20	16 5
	24	11 4		24	15 0
ROUGH LUMBER					
2 x 6	12	10 9	2 x 10	12	18 4
	16	9 4		16	16 8
	20	8 4		20	15 5
	24	7 7		24	14 1
2 x 8	12	14 8	3 x 10	12	21 0
	16	12 11		16	19 1
	20	11 6		20	17 8
	24	10 6		24	16 8
3 x 8	12	16 10	2 x 12	12	22 0
	16	15 3		16	20 0
	20	14 1		20	18 7
	24	12 11		24	17 5

Table II.—FLAT ROOF JOISTS

Supporting finished ceiling			Not supporting finished ceiling		Supporting finished ceiling			Not supporting finished ceiling	
Nominal size (inches)	Spacing c. to c.	No. 1 Dimension		No. 1 Dimension	Nominal size (inches)	Spacing c. to c.	No. 1 Dimension		No. 1 Dimension
	In.	*Ft. In.*		*Ft. In.*		*In.*	*Ft. In.*		*Ft. In.*
2 x 6	12	9 8		11 1	2 x 10	12	18 1		20 6
	16	8 4		9 8		16	15 7		18 1
	20	7 6		8 7		20	14 0		16 2
	24	6 10		7 10		24	12 9		14 9
2 x 8	12	13 4		15 5	3 x 10	12	22 11		24 0
	16	11 7		13 4		16	19 10		21 9
	20	10 4		11 11		20	17 9		20 3
	24	9 5		10 11		24	16 3		18 9
3 x 8	12	16 11		19 0	2 x 12	12	22 7		24 10
	16	14 8		16 11		16	19 6		22 5
	20	13 2		15 2		20	17 6		20 2
	24	12 0		13 10		24	15 11		18 5
ROUGH LUMBER									
2 x 6	12	11 5		13 2	2 x 10	12	21 1		23 1
	16	9 10		11 5		16	18 3		21 0
	20	8 10		10 2		20	16 4		18 10
	24	8 2		9 4		24	14 11		17 3
2 x 8	12	15 9		18 2	3 x 10	12	25 10		26 5
	16	13 8		15 9		16	22 4		24 0
	20	12 3		14 1		20	20 0		22 4
	24	11 2		12 11		24	18 3		21 0
3 x 8	12	19 4		21 2	2 x 12	12	26 1		27 9
	16	16 8		19 4		16	22 7		25 2
	20	15 0		17 4		20	20 2		23 4
	24	13 8		15 10		24	18 5		21 3

PINE, EASTERN, WHITE

Table III.—CEILING JOISTS

Limited Attic Storage			No Attic Storage		
Nominal size (inches)	Spacing c. to c.	No. 1 Dimension	Nominal size (inches)	Spacing c. to c.	No. 1 Dimension
	In.	*Ft. In.*		*In.*	*Ft. In.*
2 x 4	12	6 4	2 x 4	12	9 9
	16	5 5		16	9 0
	20	4 10		20	8 1
	24	4 5		24	7 8
2 x 6	12	11 1	2 x 6	12	15 3
	16	9 8		16	14 0
	20	8 7		20	12 10
	24	7 10		24	12 1
2 x 8	12	15 5	2 x 8	12	20 5
	16	13 4		16	18 8
	20	11 11		20	17 1
	24	10 11		24	16 2
2 x 10	12	20 5	2 x 10	12	-- --
	16	18 1		16	-- --
	20	16 2		20	---- --
	24	14 9		24	-- --

Table IV.—RAFTERS

[Roof slopes greater than 3 in 12. Span is the actual length of the rafter between the plate and the ridge or an intermediate support]

Nominal size (inches)	Spacing c. to c.	No. 1 Dimension	
		Light roofing	Heavy roofing
	In.	*Ft. In.*	*Ft. In.*
2 x 4	12	7 11	7 0
	16	6 10	6 1
	20	6 2	5 5
	24	5 7	5 0
2 x 6	12	14 0	12 5
	16	12 1	10 9
	20	10 10	9 8
	24	9 11	8 9
2 x 8	12	19 4	17 3
	16	16 9	14 11
	20	15 0	13 4
	24	13 8	12 2
2 x 10	12	26 2	23 4
	16	22 8	20 2
	20	20 3	18 1
	24	18 6	16 6

Light Roofing: Material weighing, in place, 5 pounds or less per square foot.
Heavy Roofing: Material weighing, in place, over 5 pounds per square foot.

PINE, SOUTHERN YELLOW

Table I.—FLOOR JOISTS

DRESSED LUMBER, Includes S4S and S2E

Nominal size (inches)	Spacing c. to c.	No. 1 dense 2-inch dimension	No. 1 2-inch dimension	No. 2 dense 2-inch dimension	No. 2 2-inch dimension
	In.	*Ft. In.*	*Ft. In.*	*Ft. In.*	*Ft. In.*
2 x 6	12	11 3	11 3	11 3	11 3
	16	10 2	10 2	10 2	10 2
	20	9 6	9 6	9 6	9 2
	24	8 11	8 11	8 11	8 4
2 x 8	12	15 0	15 0	15 0	15 0
	16	13 8	13 8	13 8	13 8
	20	12 8	12 8	12 8	12 2
	24	11 11	11 11	11 11	11 2
3 x 8*	12	17 8	-- --	-- --	-- --
	16	16 0	-- --	-- --	-- --
	20	14 11	-- --	-- --	-- --
	24	14 0	-- --	-- --	-- --
2 x 10	12	19 0	19 0	19 0	19 0
	16	17 3	17 3	17 3	17 3
	20	16 1	16 1	16 1	15 5
	24	15 1	15 1	15 1	14 1
3 x 10*	12	22 4	-- --	-- --	-- --
	16	20 3	-- --	-- --	-- --
	20	18 10	-- --	-- --	-- --
	24	17 9	-- --	-- --	-- --
2 x 12	12	23 0	23 0	23 0	23 0
	16	20 10	20 10	20 10	20 10
	20	19 5	19 5	19 5	18 8
	24	18 3	18 3	18 3	17 1
ROUGH LUMBER					
2 x 6	12	12 10	12 10	12 10	12 10
	16	11 8	11 8	11 8	11 8
	20	10 10	10 10	10 10	10 10
	24	10 3	10 3	10 3	9 11
2 x 8	12	17 2	17 2	17 2	17 2
	16	15 7	15 7	15 7	15 7
	20	14 6	14 6	14 6	14 5
	24	13 7	13 7	13 7	13 2
3 x 8*	12	19 8	-- --	-- --	-- --
	16	17 10	-- --	-- --	-- --
	20	16 7	-- --	-- --	-- --
	24	15 7	-- --	-- --	-- --
2 x 10	12	21 6	21 6	21 6	21 6
	16	19 6	19 6	19 6	19 6
	20	18 1	18 1	18 1	18 1
	24	17 1	17 1	17 1	16 6
3 x 10*	12	24 7	-- --	-- --	-- --
	16	22 4	-- --	-- --	-- --
	20	20 8	-- --	-- --	-- --
	24	19 6	-- --	-- --	-- --
2 x 12	12	25 9	25 9	25 9	25 9
	16	23 5	23 5	23 5	23 5
	20	21 8	21 8	21 8	21 8
	24	20 5	20 5	20 5	19 10

* Dense No. 1 Structural 1600-f, No. 1 Dense 1400-f and No. 1—1200-f grades.

PINE, SOUTHERN YELLOW

Table II.—FLAT ROOF JOISTS

DRESSED LUMBER, Includes S4S and S2E

Supporting finished ceiling								Not supporting finished ceiling							
Nominal size (inches)	Spacing c. to c.	No. 1 dense 2-inch dimension		No. 1 2-inch dimension		No. 2 dense 2-inch dimension		No. 2 2-inch dimension		Nominal size (inches)	Spacing c. to c.	No. 1 dense 2-inch dimension		No. 1 2-inch dimension		No. 2 dense 2-inch dimension		No. 2 2-inch dimension	
	In.	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*		*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*
2 x 6	12	14	2	14	2	13	5	12	7	2 x 6	12	14	2	14	2	14	2	14	2
	16	12	10	12	6	11	7	10	10		16	12	10	12	10	12	10	12	7
	20	12	0	11	2	10	4	9	8		20	12	0	12	0	11	11	11	3
	24	11	0	10	2	9	5	8	10		24	11	3	11	3	10	11	10	3
2 x 8	12	18	11	18	11	17	10	16	8	2 x 8	12	18	11	18	11	18	11	18	11
	16	17	2	16	8	15	5	14	6		16	17	2	17	2	17	2	16	9
	20	16	0	14	11	13	10	13	0		20	16	0	16	0	15	11	15	0
	24	14	8	13	7	12	7	11	10		24	15	0	15	0	14	7	13	8
3 x 8*	12	22	2	--	--	22	2	--	--	3 x 8*	12	22	2	--	--	22	2	--	--
	16	20	2	--	--	19	2	--	--		16	20	2	--	--	20	2	--	--
	20	18	9	--	--	17	2	--	--		20	18	9	--	--	18	9	--	--
	24	17	7	--	--	15	8	--	--		24	17	7	--	--	17	7	--	--
2 x 10	12	23	11	23	11	22	7	21	2	2 x 10	12	23	11	23	11	23	11	23	11
	16	21	8	21	0	19	6	18	4		16	21	8	21	8	21	8	21	3
	20	20	3	18	10	17	6	16	5		20	20	3	20	3	20	2	19	0
	24	18	7	17	2	15	11	15	0		24	19	0	19	0	18	5	17	4
3 x 10*	12	28	2	--	--	28	1	--	--	3 x 10*	12	28	2	--	--	28	2	--	--
	16	25	7	--	--	24	4	--	--		16	25	7	--	--	25	7	--	--
	20	23	9	--	--	21	9	--	--		20	23	9	--	--	23	9	--	--
	24	22	4	--	--	19	11	--	--		24	22	4	--	--	22	4	--	--
2 x 12	12	29	0	29	0	27	4	25	8	2 x 12	12	29	0	29	0	29	0	29	0
	16	26	4	25	6	23	8	22	2		16	26	4	26	4	26	4	25	8
	20	24	6	22	10	21	2	19	10		20	24	6	24	6	24	6	23	0
	24	22	7	20	10	19	4	18	2		24	23	0	23	0	22	5	21	0
ROUGH LUMBER																			
2 x 6	12	16	2	16	2	15	10	14	10	2 x 6	12	16	2	16	2	16	2	16	2
	16	14	9	14	9	13	8	12	10		16	14	9	14	9	14	9	14	9
	20	13	8	13	2	12	3	11	6		20	13	8	13	8	13	8	13	3
	24	12	11	12	2	11	4	10	7		24	12	11	12	11	12	11	12	1
2 x 8	12	21	8	21	8	21	1	19	9	2 x 8	12	21	8	21	8	21	8	21	8
	16	19	7	19	7	18	3	17	1		16	19	7	19	7	19	7	19	7
	20	18	3	17	7	16	4	15	4		20	18	3	18	3	18	3	17	8
	24	17	2	16	1	14	11	14	0		24	17	2	17	2	17	2	16	2
3 x 8*	12	24	10	--	--	24	10	--	--	3 x 8*	12	24	10	--	--	24	10	--	--
	16	22	5	--	--	21	11	--	--		16	22	5	--	--	22	5	--	--
	20	20	10	--	--	19	7	--	--		20	20	10	--	--	20	10	--	--
	24	19	8	--	--	17	11	--	--		24	19	8	--	--	19	8	--	--
2 x 10	12	27	0	27	0	26	5	24	9	2 x 10	12	27	0	27	0	27	0	27	0
	16	24	7	24	7	22	10	21	5		16	24	7	24	7	24	7	24	7
	20	22	10	22	0	20	5	19	2		20	22	10	22	10	22	10	22	2
	24	21	5	20	1	18	8	17	6		24	21	5	21	5	21	5	20	2
3 x 10*	12	31	0	--	--	31	0	--	--	3 x 10*	12	31	0	--	--	31	0	--	--
	16	28	1	--	--	27	5	--	--		16	28	1	--	--	28	1	--	--
	20	26	2	--	--	24	6	--	--		20	26	2	--	--	26	2	--	--
	24	24	7	--	--	22	4	--	--		24	24	7	--	--	24	7	--	--
2 x 12	12	32	5	32	5	31	7	29	8	2 x 12	12	32	5	32	5	32	5	32	5
	16	29	6	29	6	27	5	25	8		16	29	6	29	6	29	6	29	6
	20	27	5	26	5	24	6	23	0		20	27	5	27	5	27	5	26	6
	24	25	10	24	1	22	5	21	0		24	25	10	25	10	25	10	24	2

* Dense No. 1 Structural grade. 1600-f and No. 1 Dense 1400-f grades in first column. No. 1—1200-f grade in third column.

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PINE, SOUTHERN YELLOW

Table III.—CEILING JOISTS

Limited Attic Storage									No Attic Storage									
Nominal size (inches)	Spacing c. to c.	No. 1 dense 2-inch dimension		No. 1 2-inch dimension		No. 2 dense 2-inch dimension		No. 2 2-inch dimension		Nominal size (inches)	Spacing c. to c.	No. 1 dense 2-inch dimension		No. 1 2-inch dimension		No. 2 dense 2-inch dimension		No. 2 2-inch dimension	
	In.	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*		*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*
2 x 4	12	9	2	9	2	9	2	9	2	2 x 4	12	11	6	11	6	11	6	11	6
	16	8	3	8	3	8	3	8	1		16	10	6	10	6	10	6	10	6
	20	7	9	7	9	7	8	7	3		20	9	8	9	8	9	8	9	8
	24	7	3	7	3	7	0	6	7		24	9	1	9	1	9	1	9	1
2 x 6	12	14	2	14	2	14	2	14	2	2 x 6	12	17	10	17	10	17	10	17	10
	16	12	10	12	10	12	10	12	7		16	16	5	16	5	16	5	16	5
	20	12	0	12	0	11	11	11	3		20	15	0	15	0	15	0	15	0
	24	11	3	11	3	10	11	10	3		24	14	2	14	2	14	2	14	2
2 x 8	12	18	11	18	11	18	11	18	11	2 x 8	12	23	10	23	10	23	10	23	10
	16	17	1	17	1	17	1	16	9		16	21	10	21	10	21	10	21	10
	20	16	0	16	0	15	11	15	0		20	20	0	20	0	20	0	20	0
	24	15	0	15	0	14	7	13	8		24	18	11	18	11	18	11	18	11
2 x 10	12	23	11	23	11	23	11	23	11	2 x 10	12	--	--	--	--	--	--	--	--
	16	21	8	21	8	21	8	21	3		16	--	--	--	--	--	--	--	--
	20	20	3	20	3	20	2	19	0		20	--	--	--	--	--	--	--	--
	24	19	0	19	0	18	5	17	4		24	--	--	--	--	--	--	--	--

Table IV.—RAFTERS

Roof slopes greater than 3 in 12. Span is the actual length of the rafter between the plate and the ridge or an intermediate support}

Nominal size (inches)	Spacing c. to c.	No. 1 dense 2-inch dimension				No. 1 2-inch dimension				No. 2 dense 2-inch dimension				No. 2 2-inch dimension			
		Light roofing		Heavy roofing		Light roofing		Heavy roofing		Light roofing		Heavy roofing		Light roofing		Heavy roofing	
	In.	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*
2 x 4	12	14	7	12	11	13	6	12	0	12	6	11	2	11	9	10	5
	16	12	8	11	3	11	8	10	4	10	10	9	8	10	2	9	0
	20	11	4	10	1	10	5	9	3	9	8	8	7	9	1	8	1
	24	10	4	9	2	9	6	8	6	8	10	7	10	8	4	7	4
2 x 6	12	22	7	20	1	20	10	18	7	19	5	17	3	18	2	16	2
	16	19	7	17	5	18	1	16	1	16	10	14	11	15	9	14	0
	20	17	6	15	7	16	2	14	5	15	0	13	4	14	1	12	6
	24	16	0	14	3	14	9	13	2	13	9	12	2	12	11	11	5
2 x 8	12	30	2	26	10	27	10	24	10	25	10	23	0	24	3	21	7
	16	26	2	23	3	24	2	21	5	22	5	19	11	21	0	18	8
	20	23	5	20	10	21	7	19	2	20	0	17	10	18	10	16	9
	24	21	4	19	0	19	8	17	6	18	4	16	4	17	2	15	3
2 x 10	12	38	2	34	0	35	3	31	5	32	9	29	2	30	8	27	4
	16	33	0	29	5	30	6	27	2	28	4	25	2	26	7	23	8
	20	29	7	26	4	27	3	24	4	25	4	22	7	23	9	21	2
	24	27	0	24	0	24	11	22	2	23	2	20	7	21	8	19	4

Light Roofing: Material weighing, in place, 5 pounds or less per square foot.
Heavy Roofing: Material weighing, in place, over 5 pounds per square foot.

REDCEDAR, WESTERN

Table I.—FLOOR JOISTS

DRESSED LUMBER, Includes S4S and S2E

Nominal size (inches)	Spacing c. to c.	Select merch. dimension	No. 1 Dimension	No. 2 Dimension	No. 3 Dimension
	In.	*Ft. In.*	*Ft. In.*	*Ft. In.*	*Ft. In.*
2 x 6	12	9 7	9 7	7 7	6 2
	16	8 9	8 9	6 7	5 4
	20	8 1	8 1	5 10	4 9
	24	7 8	7 4	5 4	4 4
2 x 8	12	12 10	12 10	11 2	9 6
	16	11 8	11 8	9 8	8 3
	20	10 10	10 9	8 8	7 4
	24	10 2	9 10	7 11	6 9
3 x 8	12	15 1	15 1	14 2	12 1
	16	13 8	13 8	12 4	10 6
	20	12 9	12 9	11 0	9 4
	24	12 0	12 0	10 0	8 7
2 x 10	12	16 3	16 3	14 1	13 6
	16	14 9	14 9	12 3	11 8
	20	13 9	13 7	10 11	10 5
	24	12 11	12 5	10 0	9 6
3 x 10	12	19 0	19 0	17 11	17 1
	16	17 4	17 4	15 6	14 10
	20	16 1	16 1	13 11	13 3
	24	15 2	15 2	12 8	12 1
2 x 12	12	19 9	19 9	18 7	15 6
	16	17 10	17 10	16 1	13 5
	20	16 8	16 5	14 5	12 0
	24	15 8	15 0	13 2	10 11
ROUGH LUMBER					
2 x 6	12	11 0	11 0	8 11	7 4
	16	10 0	10 0	7 9	6 4
	20	9 3	9 3	6 11	5 8
	24	8 9	8 8	6 4	5 2
2 x 8	12	14 8	14 8	13 2	11 3
	16	13 4	13 4	11 5	9 9
	20	12 4	12 4	10 3	8 8
	24	11 8	11 7	9 4	7 11
3 x 8	12	16 10	16 10	16 2	13 10
	16	15 3	15 3	14 0	11 11
	20	14 2	14 2	12 6	10 8
	24	13 4	13 4	11 5	9 9
2 x 10	12	18 4	18 4	16 6	15 8
	16	16 8	16 8	14 3	13 7
	20	15 5	15 5	12 9	12 2
	24	14 7	14 6	11 8	11 2
3 x 10	12	21 0	21 0	20 2	19 3
	16	19 1	19 1	17 6	16 8
	20	17 8	17 8	15 8	14 11
	24	16 8	16 8	14 4	13 8
2 x 12	12	22 0	22 0	21 6	17 11
	16	20 0	20 0	18 8	15 6
	20	18 7	18 7	16 8	13 11
	24	17 6	17 5	15 2	12 8

REDCEDAR, WESTERN

Table II.—FLAT ROOF JOISTS

DRESSED LUMBER, Includes S4S and S2E

Supporting finished ceiling										Not supporting finished ceiling									
Nominal size (inches)	Spacing c. to c.	Select merch. dimension		No. 1 Dimension		No. 2 Dimension		No. 3 Dimension		Nominal size (inches)	Spacing c. to c.	Select merch. dimension		No. 1 Dimension		No. 2 Dimension		No. 3 Dimension	
	In.	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*		*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*
2 x 6	12	12	0	11	0	8	0	6	6	2 x 6	12	12	2	12	2	9	3	7	7
	16	10	4	9	6	6	11	5	8		16	11	0	11	0	8	0	6	6
	20	9	3	8	6	6	2	5	1		20	10	3	9	10	7	2	5	10
	24	8	5	7	9	5	8	4	8		24	9	8	9	0	6	7	5	4
2 x 8	12	16	8	14	8	11	10	10	1	2 x 8	12	16	2	16	2	13	8	11	8
	16	14	6	12	9	10	3	8	9		16	14	8	14	8	11	10	10	1
	20	13	0	11	5	9	2	7	10		20	13	7	13	2	10	7	9	0
	24	11	10	10	4	8	4	7	2		24	12	10	12	0	9	8	8	3
3 x 8	12	19	0	18	8	15	0	12	10	3 x 8	12	19	0	19	0	17	4	14	10
	16	17	3	16	2	13	0	11	1		16	17	3	17	3	15	0	12	10
	20	16	0	14	6	11	8	9	11		20	16	0	16	0	13	6	11	6
	24	15	1	13	3	10	8	9	1		24	15	1	15	1	12	3	10	6
2 x 10	12	20	6	18	7	15	0	14	3	2 x 10	12	20	6	20	6	17	3	16	6
	16	18	4	16	1	13	0	12	4		16	18	8	18	7	14	11	14	4
	20	16	5	14	5	11	7	11	1		20	17	3	16	8	13	4	12	9
	24	15	0	13	2	10	7	10	1		24	16	3	15	2	12	3	11	8
3 x 10	12	24	0	23	8	19	0	18	1	3 x 10	12	24	0	24	0	22	0	21	0
	16	21	9	20	5	16	5	15	8		16	21	9	21	9	19	0	18	2
	20	20	3	18	4	14	9	14	1		20	20	3	20	3	17	0	16	3
	24	19	0	16	9	13	5	12	10		24	19	1	19	1	15	6	14	10
2 x 12	12	24	10	22	7	19	8	16	5	2 x 12	12	24	10	24	10	22	9	18	11
	16	22	5	19	6	17	1	14	2		16	22	5	22	5	19	9	16	5
	20	20	4	17	6	15	3	12	8		20	20	11	20	2	17	8	14	8
	24	18	7	15	11	13	10	11	7		24	19	8	18	5	16	1	13	5
ROUGH LUMBER																			
2 x 6	12	13	10	13	0	9	6	7	9	2 x 6	12	13	10	13	10	11	0	8	11
	16	12	3	11	4	8	3	6	8		16	12	7	12	7	9	6	7	9
	20	11	0	10	1	7	4	6	0		20	11	8	11	8	8	6	6	11
	24	10	1	9	4	6	9	5	6		24	11	0	10	8	7	9	6	4
2 x 8	12	18	6	17	5	14	0	11	11	2 x 8	12	18	6	18	6	16	2	13	9
	16	16	8	15	1	12	1	10	4		16	16	8	16	8	14	0	11	11
	20	15	4	13	6	10	10	9	3		20	15	7	15	6	12	6	10	8
	24	14	0	12	4	9	11	8	5		24	14	8	14	2	11	5	9	9
3 x 8	12	21	2	21	2	17	1	14	7	3 x 8	12	21	2	21	2	19	9	16	10
	16	19	4	18	5	14	10	12	8		16	19	4	19	4	17	2	14	7
	20	17	10	16	6	13	3	11	4		20	17	10	17	10	15	4	13	1
	24	16	10	15	1	12	2	10	4		24	16	10	16	10	14	0	11	11
2 x 10	12	23	1	21	9	17	6	16	8	2 x 10	12	23	1	23	1	20	2	19	3
	16	21	0	18	10	15	1	14	5		16	21	0	21	0	17	6	16	8
	20	19	2	16	10	13	7	12	11		20	19	6	19	5	15	8	14	11
	24	17	6	15	4	12	4	11	10		24	18	4	17	9	14	3	13	7
3 x 10	12	26	5	26	5	21	5	20	5	3 x 10	12	26	5	26	5	24	9	23	7
	16	24	0	23	0	18	6	17	8		16	24	0	24	0	21	5	20	5
	20	22	4	20	7	16	7	15	10		20	22	4	22	4	19	2	18	3
	24	21	0	18	10	15	2	14	5		24	21	0	21	0	17	6	16	8
2 x 12	12	27	9	26	1	22	10	19	0	2 x 12	12	27	9	27	9	26	4	21	11
	16	25	2	22	7	19	9	16	5		16	25	2	25	2	22	10	19	0
	20	23	5	20	2	17	8	14	8		20	23	5	23	4	20	5	17	0
	24	21	5	18	5	16	2	13	5		24	22	0	21	3	18	7	15	6

REDCEDAR, WESTERN

Table III.—CEILING JOISTS

Limited Attic Storage											No Attic Storage									
Nominal size (inches)	Spacing c. to c.	Select Merchantable Dimension		No. 1 Dimension		No. 2 Dimension		No. 3 Dimension			Nominal size (inches)	Spacing c. to c.	Select Merchantable Dimension		No. 1 Dimension		No. 2 Dimension		No. 3 Dimension	
	In.	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*			*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*
2 x 4	12	7	10	6	4	4	10	--	--		2 x 4	12	9	9	9	9	8	5	--	--
	16	7	1	5	5	4	3	--	--			16	9	0	9	0	7	4	--	--
	20	6	7	4	10	3	9	--	--			20	8	1	8	1	6	6	--	--
	24	6	0	4	5	3	5	--	--			24	7	10	7	8	6	0	--	--
2 x 6	12	12	1	12	1	9	3	7	7		2 x 6	12	15	3	15	3	15	3	13	1
	16	11	0	11	0	8	0	6	6			16	14	0	14	0	13	11	11	4
	20	10	3	9	10	7	2	5	10			20	12	10	12	10	12	5	10	1
	24	9	8	9	0	6	7	5	4			24	12	1	12	1	11	4	9	3
2 x 8	12	16	2	16	2	13	8	11	8		2 x 8	12	20	5	20	5	20	5	20	2
	16	14	7	14	7	11	10	10	1			16	18	8	18	8	18	8	17	6
	20	13	8	13	2	10	7	9	0			20	17	1	17	1	17	1	15	7
	24	12	10	12	0	9	8	8	3			24	16	2	16	2	16	2	14	3
2 x 10	12	20	5	20	5	17	3	16	6		2 x 10	12	--	--	--	--	--	--	--	--
	16	18	6	18	6	14	11	14	4			16	--	--	--	--	--	--	--	--
	20	17	4	16	8	13	4	12	9			20	--	--	--	--	--	--	--	--
	24	16	3	15	2	12	3	11	8			24	--	--	--	--	--	--	--	--

Table IV.—RAFTERS

[Roof slopes greater than 3 in 12. Span is the actual length of the rafter between the plate and the ridge or an intermediate support]

Nominal size (inches)	Spacing c. to c.	Select Merchantable Dimension				No. 1 Dimension				No. 2 Dimension				No. 3 Dimension			
		Light roofing		Heavy roofing		Light roofing		Heavy roofing		Light roofing		Heavy roofing		Light roofing		Heavy roofing	
	In.	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*
2 x 4	12	10	7	9	5	7	11	7	0	6	2	5	5	4	2	--	--
	16	9	2	8	2	6	10	6	1	5	4	4	9	3	7	--	--
	20	8	3	7	4	6	2	5	5	4	9	4	3	3	3	--	--
	24	7	6	6	8	5	7	5	0	4	4	3	10	3	0	--	--
2 x 6	12	17	4	15	5	16	0	14	3	11	8	10	4	9	6	8	5
	16	15	0	13	4	13	10	12	4	10	1	9	0	8	3	7	4
	20	13	5	11	11	12	5	11	0	9	0	8	0	7	4	6	7
	24	12	3	10	11	11	4	10	0	8	3	7	4	6	9	6	0
2 x 8	12	24	3	21	7	21	4	19	0	17	2	15	4	14	7	13	0
	16	21	0	18	8	18	6	16	5	14	11	13	3	12	8	11	3
	20	18	10	16	9	16	6	14	8	13	4	11	10	11	4	10	1
	24	17	2	15	3	15	1	13	5	12	1	10	10	10	4	9	2
2 x 10	12	30	8	27	4	27	0	24	0	21	9	19	4	20	9	18	5
	16	26	7	23	8	23	5	20	10	18	10	16	9	17	11	15	11
	20	23	9	21	2	20	11	18	7	16	10	15	0	16	1	14	3
	24	21	8	19	4	19	1	17	0	15	4	13	8	14	8	13	0

Light Roofing: Material weighing, in place, 5 pounds or less per square foot.
Heavy Roofing: Material weighing, in place, over 5 pounds per square foot.

REDWOOD

Table I.—FLOOR JOISTS

DRESSED LUMBER, Includes S4S and S2E

Nominal size (inches)	Spacing c. to c.	Select Heart Dimension	Construction Heart Dimension	Sap Common Dimension
	In.	*Ft. In.*	*Ft. In.*	*Ft. In.*
2 x 6	12	10 3	8 9	8 9
	16	9 0	7 7	7 7
	20	8 1	6 9	6 9
	24	7 4	6 2	6 2
2 x 8	12	13 8	13 8	13 8
	16	12 5	12 0	12 0
	20	11 6	10 9	10 9
	24	10 10	9 10	9 10
3 x 8	12	16 0	15 5	15 5
	16	14 7	13 4	13 4
	20	13 7	11 11	11 11
	24	12 9	10 11	10 11
2 x 10	12	17 3	17 3	17 3
	16	15 8	15 2	15 2
	20	14 7	13 7	13 7
	24	13 9	12 5	12 5
3 x 10	12	20 2	20 1	20 1
	16	18 5	17 6	17 6
	20	17 2	15 8	15 8
	24	16 1	14 4	14 4
2 x 12	12	20 10	20 10	20 10
	16	19 0	18 5	18 5
	20	17 8	16 5	16 5
	24	16 7	15 0	15 0

ROUGH LUMBER

2 x 6	12	11 8	10 4	10 4
	16	10 8	8 11	8 11
	20	9 6	8 0	8 0
	24	8 8	7 4	7 4
2 x 8	12	15 7	15 7	15 7
	16	14 2	14 2	14 2
	20	13 2	12 9	12 9
	24	12 5	11 7	11 7
3 x 8	12	17 10	17 7	17 7
	16	16 3	15 2	15 2
	20	15 1	13 7	13 7
	24	14 2	12 5	12 5
2 x 10	12	19 6	19 6	19 6
	16	17 7	17 7	17 7
	20	16 5	15 11	15 11
	24	15 6	14 6	14 6
3 x 10	12	22 4	22 4	22 4
	16	20 3	19 8	19 8
	20	18 10	17 8	17 8
	24	17 9	16 2	16 2
2 x 12	12	23 5	23 5	23 5
	16	21 2	21 2	21 2
	20	19 9	19 1	19 1
	24	18 7	17 5	17 5

REDWOOD

Table II.—FLAT ROOF JOISTS

DRESSED LUMBER, Includes S4S and S2E

Supporting finished ceiling							Not supporting finished ceiling						
Nominal size (inches)	Spacing c. to c.	Select Heart Dimension		Construction Heart Dimension		Sap Common Dimension	Nominal size (inches)	Spacing c. to c.	Select Heart Dimension		Construction Heart Dimension		Sap Common Dimension
	In.	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.* *In.*		*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.* *In.*
2 x 6	12	11	0	9	3	9 3	2 x 6	12	12	8	10	8	10 8
	16	9	6	8	0	8 0		16	11	0	9	3	9 3
	20	8	6	7	2	7 2		20	9	10	8	3	8 3
	24	7	9	6	6	6 6		24	9	0	7	7	7 7
2 x 8	12	17	1	14	8	14 8	2 x 8	12	17	2	17	0	17 0
	16	14	10	12	9	12 9		16	15	7	14	8	14 8
	20	13	3	11	5	11 5		20	14	6	13	2	13 2
	24	12	1	10	4	10 4		24	13	8	12	0	12 0
3 x 8	12	20	2	16	4	16 4	3 x 8	12	20	2	18	10	18 10
	16	18	4	14	1	14 1		16	18	4	16	4	16 4
	20	17	0	12	8	12 8		20	17	0	14	7	14 7
	24	16	0	11	7	11 7		24	16	0	13	4	13 4
2 x 10	12	21	8	18	7	18 7	2 x 10	12	21	9	21	6	21 6
	16	18	9	16	1	16 1		16	19	10	18	7	18 7
	20	16	9	14	5	14 5		20	18	5	16	8	16 8
	24	15	4	13	2	13 2		24	17	4	15	2	15 2
3 x 10	12	25	7	21	5	21 5	3 x 10	12	25	7	24	10	24 10
	16	23	2	18	7	18 7		16	23	2	21	5	21 5
	20	21	7	16	7	16 7		20	21	7	19	2	19 2
	24	20	3	15	2	15 2		24	20	3	17	6	17 6
2 x 12	12	26	4	22	7	22 7	2 x 12	12	26	4	26	0	26 0
	16	24	0	19	6	19 6		16	24	0	22	7	22 7
	20	22	0	17	6	17 6		20	22	3	20	2	20 2
	24	20	1	15	11	15 11		24	20	10	18	5	18 5
ROUGH LUMBER													
2 x 6	12	13	0	11	0	11 0	2 x 6	12	14	9	12	8	12 8
	16	11	4	9	6	9 6		16	13	1	11	0	11 0
	20	10	1	8	6	8 6		20	11	8	9	10	9 10
	24	9	4	7	10	7 10		24	10	8	8	11	8 11
2 x 8	12	19	7	17	5	17 5	2 x 8	12	19	7	19	7	19 7
	16	17	6	15	1	15 1		16	17	10	17	5	17 5
	20	15	8	13	6	13 6		20	16	7	15	6	15 6
	24	14	4	12	4	12 4		24	15	7	14	2	14 2
3 x 8	12	22	5	18	7	18 7	3 x 8	12	22	5	21	6	21 6
	16	20	5	16	1	16 1		16	20	5	18	8	18 8
	20	19	0	14	5	14 5		20	19	0	16	8	16 8
	24	17	10	13	2	13 2		24	17	10	15	2	15 2
2 x 10	12	24	7	21	9	21 9	2 x 10	12	24	7	24	7	24 7
	16	21	10	18	10	18 10		16	22	4	21	9	21 9
	20	19	7	16	10	16 10		20	20	9	19	5	19 5
	24	17	11	15	4	15 4		24	19	6	17	9	17 9
3 x 10	12	28	2	24	2	24 2	3 x 10	12	28	2	27	10	27 10
	16	25	7	20	11	20 11		16	25	7	24	2	24 2
	20	23	8	18	8	18 8		20	23	8	21	7	21 7
	24	22	4	17	1	17 1		24	22	4	19	9	19 9
2 x 12	12	29	6	26	1	26 1	2 x 12	12	29	6	29	6	29 6
	16	26	10	22	7	22 7		16	26	10	26	1	26 1
	20	24	10	20	2	20 2		20	24	10	23	4	23 4
	24	23	3	18	5	18 5		24	23	5	21	3	21 3

Table III.—CEILING JOISTS

Limited Attic Storage							No Attic Storage						
Nominal size (inches)	Spacing c. to c.	Select Heart Dimension		Construction Heart Dimension		Sap Common Dimension	Nominal size (inches)	Spacing c. to c.	Select Heart Dimension		Construction Heart Dimension		Sap Common Dimension
	In.	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.* *In.*		*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.* *In.*
2 x 4	12	7	5	5	8	5 8	2 x 4	12	10	5	9	9	9 9
	16	6	5	4	10	4 10		16	9	6	8	5	8 5
	20	5	9	4	3	4 3		20	8	10	7	6	7 6
	24	5	3	4	0	4 0		24	8	4	6	11	6 11
2 x 6	12	12	8	10	8	10 8	2 x 6	12	16	3	16	3	16 3
	16	11	0	9	3	9 3		16	14	11	14	11	14 11
	20	9	10	8	3	8 3		20	13	7	13	7	13 7
	24	9	0	7	7	7 7		24	12	11	12	11	12 11
2 x 8	12	17	2	17	0	17 0	2 x 8	12	21	7	21	7	21 7
	16	15	7	14	8	14 8		16	19	10	19	10	19 10
	20	14	7	13	2	13 2		20	18	1	18	1	18 1
	24	13	8	12	0	12 0		24	17	2	17	2	17 2
2 x 10	12	21	9	21	6	21 6	2 x 10	12	--	--	--	--	-- --
	16	19	8	18	7	18 7		16	--	--	--	--	-- --
	20	18	5	16	8	16 8		20	--	--	--	--	-- --
	24	17	3	15	2	15 2		24	--	--	--	--	-- --

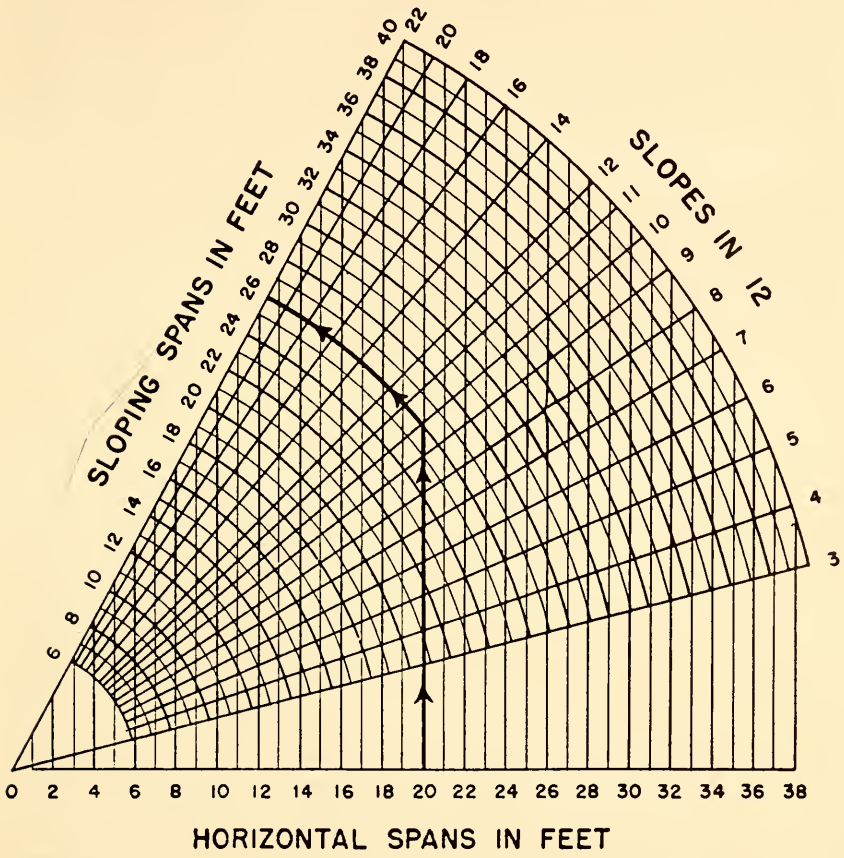
Table IV.—RAFTERS

[Roof slopes greater than 3 in 12. Span is the actual length of the rafter between the plate and the ridge or an intermediate support]

Nominal size (inches)	Spacing c. to c.	Select Heart Dimension				Construction Heart Dimension				Sap Common Dimension			
		Light roofing		Heavy roofing		Light roofing		Heavy roofing		Light roofing		Heavy roofing	
	In.	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*	*Ft.*	*In.*
2 x 4	12	9	4	8	4	7	1	6	3	7	1	6	3
	16	8	1	7	2	6	2	5	5	6	2	5	5
	20	7	3	6	5	5	6	4	10	5	6	4	10
	24	6	8	5	11	5	0	4	5	5	0	4	5
2 x 6	12	16	0	14	3	13	5	11	11	13	5	11	11
	16	13	10	12	4	11	8	10	4	11	8	10	4
	20	12	5	11	0	10	5	9	3	10	5	9	3
	24	11	4	10	0	9	6	8	5	9	6	8	5
2 x 8	12	24	10	22	1	21	4	19	0	21	4	19	0
	16	21	6	19	1	18	6	16	5	18	6	16	5
	20	19	3	17	1	16	6	14	8	16	6	14	8
	24	17	6	15	7	15	1	13	5	15	1	13	5
2 x 10	12	31	5	28	0	27	0	24	0	27	0	24	0
	16	27	2	24	2	23	5	20	10	23	5	20	10
	20	24	4	21	8	20	11	18	7	20	11	18	7
	24	22	2	19	9	19	1	17	0	19	1	17	0

Light Roofing: Material weighing, in place, 5 pounds or less per square foot.
Heavy Roofing: Material weighing, in place, over 5 pounds per square foot.

RAFTER SPAN, CONVERSION DIAGRAM



To find the rafter span when its horizontal span and slope are known, follow the vertical line from the horizontal span to its intersection with the radial line of the slope. From the intersection follow the curve line to the sloping span. The diagram also may be used to determine the horizontal span when the sloping span and slope are known, or to determine the slope when the sloping and horizontal spans are known.

Example: For a horizontal span of 20 feet and a slope of 10 in 12, the sloping span of the rafter is read directly from the diagram as 26 feet.

APPENDIX B

DEFINITIONS

Alley: A narrow service way providing a secondary public means of access to abutting properties.

Building Area: The total of areas taken on a horizontal plane at the mean grade level of the principal buildings and all accessory buildings, exclusive of uncovered porches, terraces and steps.

Building Line: A line established by law or agreement beyond which a building shall not extend.

Cesspool: A covered pit with open-jointed lining into which raw sewage is discharged, the liquid portion of which is disposed of by seepage or leaching into the surrounding porous soil, the solids or sludge being retained in the pit.

Community System (water or sewerage): Any system which is not a public system or an individual system.

NOTE.—*Such systems usually serve one or more residential developments. It should be noted that a community system as herein defined may include systems defined by state law as public systems since state laws frequently define a public system as one serving a given number of families (possibly 10 or 25) regardless of ownership or control.*

Court: An open, unoccupied space bounded on two or more sides by the exterior walls of a building or by exterior walls and lot lines.

Inner Court: A court enclosed on all sides by exterior walls of a building or by exterior walls and lot lines on which walls are allowable.

Outer Court: A court enclosed on not more than three sides by exterior walls of a building or by exterior walls and lot lines on which walls are allowable, with one side or end open to a street, driveway, alley or yard.

Coverage: That percentage of the plot area covered by the building area.

Driveway: A private way for the use of vehicles and pedestrians.

Dry Well: A covered pit with open-jointed lining through which drainage from roofs, basement floors, or areaways may seep or leach into the surrounding porous soil.

Dwelling: A building designed or used as the living quarters for one or more families.

Detached Dwelling: A dwelling which is completely surrounded by permanent open spaces.

End Row Dwelling: Same as Semidetached Dwelling.

Multifamily Dwelling: A dwelling on one plot containing separate living units for two or more families; sometimes having joint services or facilities or both.

Dwelling: *Continued.*

Row Dwelling: A dwelling the walls on two sides of which are party or lot line walls.

Semidetached Dwelling: A dwelling one side wall of which is a party or lot line wall.

Easement: A vested or acquired right to use land, other than as a tenant, for a specific purpose; such right being held by someone other than the owner who holds title to the land.

Family: One or more persons living, sleeping, cooking and eating on the same p emises as occupants of one living unit.

Individual System (water or sewerage): A system serving a single property containing not more than four living units.

Living Facilities: Those provisions for living, sleeping, eating, cooking and sanitation, ordinarily considered as part of a permanent abode.

Living Unit: A dwelling or portion thereof, providing complete living facilities for one family, including permanently installed equipment for cooking, or provisions for the same, and including rooms for living, sleeping and eating.

Lot: A parcel of land in one ownership that is described by reference to a recorded plat or by metes and bounds.

Corner Lot: A lot abutting upon two or more streets at their intersection.

Interior Lot: A lot bounded by a street on one side only.

Lot Line: A line bounding the lot as described in the title to the property.

Plat: A map, plan or chart of a city, town, section or subdivision, indicating the location and boundaries of individual properties.

Plot: A parcel of land consisting of one or more lots or portions thereof which is described by reference to a recorded plat or by metes and bounds.

Property: A lot or plot with any buildings or other improvements located thereon.

Property Line: A recorded boundary of a plot.

Public System (water or sewerage): A system which is owned and operated by a local governmental authority or by an established public utility company which is adequately controlled by a governmental authority.

NOTE.—*Such systems are usually existing systems serving a municipality, a township, an urban county, or a water or sewer district established and directly controlled under the laws of a state.*

Required Window: A window which provides all or part of the required natural light and ventilation under these requirements.

Rooms.

Habitable Room: A room designed to be used for living, sleeping, eating or cooking, excluding bathrooms, toilet compartments, closets, halls, storage and similar spaces.

Utility Room: A room, other than a habitable room, designed or used for laundry or heating equipment or for other related purposes.

Seepage Pit: A covered pit with open-jointed lining through which septic tank or cesspool effluent or laundry wastes may seep or leach into the surrounding porous soil.

Septic Tank: A covered watertight sewage settling tank intended to retain the solids in immediate contact with the sewage flowing through the tank for a sufficient period to secure satisfactory decomposition of settled solids by bacterial action.

Shall: Indicates that which is required.

Should: Indicates that which is recommended but not required.

Solid Masonry: Masonry consisting of solid masonry units laid contiguously with the joints between the units filled with mortar, or consisting of plain concrete.

Solid Masonry Unit: A masonry unit whose net cross-sectional area in every plane parallel to the bearing surface is 75 percent or more of its gross cross-sectional area measured in the same plane.

Street: A way which affords principal means of access to abutting properties.

Wall:

Party Wall: A wall, used jointly by two parties under easement agreement, erected upon a line separating two parcels of land each of which is a separate real estate entity.

Lot Line Wall: A wall, used only by the party upon whose lot the wall is located, erected at a line separating two parcels of land each of which is a separate real estate entity.

Way: A street, alley, or other thoroughfare or easement permanently established for passage of persons or vehicles.

Yard: An open, unoccupied space on the same lot with a building, between the lot line and the extreme front, rear or side wall of the building.

Front Yard: A yard across the full width of the lot, extending from the extreme front line of the building to the front lot line.

Rear Yard: A yard across the full width of the lot, extending from the extreme rear line of the building to the rear lot line.

Side Yard: A yard between the extreme side line of the building and the adjacent side lot line, extending from the front yard to the rear yard.

APPENDIX C

REFERENCE STANDARDS

Building Materials and Equipment

The following publications contain recognized Standards which will be used as a guide in determining the acceptability of materials and equipment, except in cases where these Minimum Construction Requirements contain specific provisions which are in conflict with any of the Standards (latest edition).

Abbreviation	*Name and Address of Organization referred to*
A. C. I.	American Concrete Institute, 7460 Second Boulevard, Detroit 2, Mich.
A. G. A.	American Gas Association, 420 Lexington Avenue, New York 17, N. Y.
A. I. & S. I.	American Iron and Steel Institute, 350 Fifth Avenue, New York 1, N. Y.
A. I. S. C.	American Institute of Steel Construction, 101 Park Avenue, New York 17, N. Y.
A. P. W. A.	American Public Works Association, 1313 East Sixtieth Street, Chicago 37, Ill.
A. S. A.	American Standards Association, 70 East Forty-fifth Street, New York 17, N. Y.
A. S. H. & V. E.	American Society of Heating and Ventilating Engineers, 51 Madison Avenue, New York 10, N. Y.
A. S. M. E.	American Society of Mechanical Engineers, 29 West Thirty-ninth Street, New York 18, N. Y.
A. S. T. M.	American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa.
A. W. P. A.	American Wood Preservers Association, 839 Seventeenth Street NW., Washington 6, D. C.
A. W. W. A.	American Water Works Association, Inc., 500 Fifth Avenue, New York 18, N. Y.
B. E. & P. Q.*	Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture, Washington 25, D. C.
B. M. S.*	Building Materials and Structures Reports, National Bureau of Standards, U. S. Department of Commerce, Washington 25, D. C.
C. R. A.	California Redwood Association, 405 Montgomery Street, San Francisco 4, Calif.
C. S.*	Commercial Standards, U. S. Department of Commerce, Washington 25, D. C.
F. P. L.*	U. S. Forest Products Laboratory, Madison Wis.

*For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

Abbreviation	*Name and Address of Organization referred to*
F. S.*	Federal Specifications, Federal Supply Service, General Services Administration, Washington 25, D. C.
F. S. A.*	Federal Security Agency, Washington 25, D. C.
H. P. & A. C. C. N. A.	Heating, Piping and Air Conditioning Contractors National Association, 1250 Avenue of the Americas, New York 20, N. Y.
I. B. R. M.	Institute of Boiler and Radiator Manufacturers, 60 East Forty-second Street, New York 17, N. Y.
M. F. M. A.	Maple Flooring Manufacturers Association, 46 Washington Boulevard, Oshkosh, Wis.
N. B. F. U.	National Board of Fire Underwriters, 85 John Street, New York 7, N. Y.
N. B. S.*	National Bureau of Standards, U. S. Department of Commerce, Washington 25, D. C.
N. E. L. M. A.	Northeastern Lumber Manufacturers Association, Inc., 271 Madison Avenue, New York 16, N. Y.
N. F. P. A.	National Fire Protection Association, 60 Batterymarch Street, Boston 10, Mass.
N. H. & H. M. A.	Northern Hemlock and Hardwood Manufacturers' Association, Oshkosh, Wis.
N. H. L. A.	National Hardwood Lumber Association, 59 East Van Buren Street, Chicago 5, Ill.
N. O. F. M. A.	National Oak Flooring Manufacturers Association, 814 Sterick Building, Memphis 3, Tenn.
N. P. M. A.	Northern Pine Manufacturers Association, 4329 Oakland Avenue, Minneapolis 7, Minn.
N. W. A. H. & A. C. A.	National Warm Air Heating and Air Conditioning Association, 145 Public Square, Cleveland 14, Ohio.
P. C. A.	Portland Cement Association, 33 West Grand Avenue, Chicago 10, Ill.
S. B. I.	Steel Boiler Institute, 1207 Land Title Building, Broad and Chestnut Streets, Philadelphia 10, Pa.
S. C. M. A.	Southern Cypress Manufacturers Association, 507 Barnett National Bank Building, Jacksonville 1, Fla.
S. J. I.	Steel Joist Institute, 1346 Connecticut Avenue NW, Washington 6, D. C.
S. P. I. B.	Southern Pine Inspection Bureau, Canal Building, New Orleans 4, La.
S. P. R.*	Simplified Practice Recommendations, U. S. Department of Commerce, Washington, D. C.
U. L.	Underwriters Laboratories, Inc., 207 East Ohio Street, Chicago 11, Ill.
W. C. L. A.	West Coast Lumbermen's Association, 1410 Southwest Morrison Street, Portland 5, Oreg.
W. P. A.	Western Pine Association, 510 Yeon Building, Portland 4, Oreg.

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Subject	*Source and specification number or volume*
Aggregates, concrete	F. S.–SS–A–281a
	A. S. T. M.–C–33
lightweight	A. S. T. M.–C–130
masonry mortar	A. S. T. M.–C–144
Asbestos millboard	F. S.–HH–M–351a
Asbestos-cement; also see siding, shingles.	
Asbestos-cement sheets, flat	F. S.–SS–S–283
	A. S. T. M.–C–220
corrugated	A. S. T. M.–C–221
Asphaltum roof coating	F. S.–SS–R–451
Blinds; see shades, venetian blinds.	
Bitumized-fibre drain and sewer pipe	C. S.–116
Brick, building, clay or shale	F. S.–SS–B–656
	A. S. T. M.–C–62
clay or shale facing	A. S. T. M.–C–216
concrete	F. S.–SS–B–663
	A. S. T. M.–C–55
sand lime	F. S.–SS–B–681
	A. S. T. M.–C–73
fire	F. S.–HH–B–671c
	A. S. T. M.–C–27
silica	F. S.–HH–B–681
Building paper; see paper.	
Built-up roofing materials; see roofing.	
Calking	F. S.–TT–C–598
Cast stone	A. C. I.–704
	F. S.–SS–S–721
Cement, Keene's	F. S.–SS–C–161
	A. S. T. M.–C–61
portland	F. S.–SS–C–192
	A. S. T. M.–C–150
prepared masonry (for mortar)	F. S.–SS–C–181b
	A. S. T. M.–C–91
bituminous plastic	F. S.–SS–C–153
Concrete, ready-mixed	A. S. T. M.–C–94
Concrete, reinforced	A. C. 1. Building Code
Concrete reinforcing; see steel.	
Concrete block, hollow	F. S.–SS–C–621
load-bearing	A. S. T. M.–C–90
non-load-bearing	F. S.–SS–C–621
	A. S. T. M.–C–129
solid, load-bearing	A. S. T. M.–C–145
Copper, sheet	F. S.–QQ–C–501a
Doors, fir	C. S.–73
fir entrance	C. S.–91
hardwood veneered	C. S.–171
Ponderosa pine	C. S.–120

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Subject	*Source and specification number or volume*
Electric:	
Regulations for electric wiring and apparatus	N. B. F. U.–70
List of inspected electrical equipment	U. L.
Naticnal Electric Code	N. F. P. A.
Enamel; see paint.	
Expansion joint fillers, preformed	F. S.–HH–F–334
	A. S. T. M.–D–994
resilient	F. S.–HH–F–341
	A. S. T. M.–D–544
Felt; see roofing.	
Fencing, wire	F. S.–RR–F–221a
Fiberboard, insulating	F. S.–LLL–F–321b
	A. S. T. M.–C–208
	C. S.–42
structural	F. S.–LLL–F–311
homogeneous	C. S.–112
Fire clay, plastic	F. S.–HH–R–191
	A. S. T. M.–C–105
ground	F. S.–HH–B–671c
Flashing, cotton fabric	F. S.–HH–C–581a
	A. S. T. M.–D–173
metal; see copper sheet and sheet metal.	
Flooring, oak	C. S.–56
	N. O. F. M. A.
hardwood block	F. S.–NN–F–476
maple	M. F. M. A.
Galvanized sheet metal; see sheet metal.	
Glass, flat for glazing purposes	F. S.–DD–G–451a
Hardware, builders'	C. S.–22
hinges	F. S.–FF–H–116b
locks and door trim	F. S.–FF–H–106a
door closers	F. S.–FF–H–121a
shelf and miscellaneous	F. S.–FF–H–111a
Heating; see general heating references.	
Heat insulation; see thermal insulation.	
Incinerators	N. B. F. U.–82
Insulation; see sound insulation, thermal insulation, fiberboard.	
Lath, gypsum board	F. S.–SS–P–431a
	A. S. T. M.–C–37
metal	F. S.–QQ–B–101c
	S. P. R.–R–3
Lathing and furring	A. S. A.–A42.3
Lead bends and traps	F. S.–WW–P–325
pipe	F. S.–WW–P–325
sheet	F. F.–QQ–L–201

Subject	*Source and specification number or volume*
Lime, quick	F. S.–SS–Q–351
	A. S. T. M.–C–5
hydrated	F. S.–SS–L–351
	A. S. T. M.–C–6
Linoleum, plain, jaspe and marbleized	F. S.–LLL–L–367
inlaid and molded	F. S.–LLL–L–359
Lumber, also see general references.	
standards for softwood	S. P. R.–R–16
softwood	F. S.–MM–L–751c
Lumber grading rules, baldcypress	N. H. L. A.; S. C. M. A.
Douglas fir, coast region	W. C. L. A.
Douglas fir, Rocky Mountain region	W. P. A.
fir, balsam	N. E. L. M. A.
fir, white	W. P. A.
hemlock, eastern	N. H. & H. M. A.
hemlock, western	W. C. L. A.
larch, western	W. P. A.
pine, eastern white	N. P. M. A.
pine, western white	W. P. A.
pine, red	N. P. M. A.; N. H. & H. M. A.
pine, southern yellow	S. P. I. B.
pine, longleaf	S. P. I. B.
red cedar, western	W. C. L. A.
redwood	C. R. A.
spruce, red and white	N. E. L. M. A.; N. H. & H. M. A.
spruce, Engelmann	W. P. A.
spruce, Sitka	W. C. L. A.
tamarack	N. H. & H. M. A.
Metal roofing; see copper, lead, tin, zinc.	
Mortar; see cement, aggregates.	
Nails	F. S.–FF–N–101
	S. P. R.–R–223
Paint, cement-water	F. S.–TT–P–21
exterior primer ready-mixed white	F. S.–TT–P–25a
exterior ready-mixed	F. S.–TT–P–102
interior semi-gloss enamel	F. S.–TT–E–508
interior resin-base	F. S.–TT–P–88a
primer-sealer for plaster and wallboard	F. S.–TT–P–56a
primer zinc-dust-zinc oxide for zinc surfaces	F. S.–TT–P–641
Paper, sheathing, waterproof	F. S.–UU–P–147
Pipe; also see lead, bitumized, water.	
asbestos-cement	F. S.–SS–P–351
brass	F. S.–WW–P–351
	A. S. T. M–B–43
cast-iron soil	F. S.–WW–P–401
	A. S. T. M.–A–72

Subject	*Source and specification number or volume*
Pipe. *Continued.*	
cast-iron drainage (threaded)	F. S.–WW–P–356
cast-iron drainage, fittings for	F. S.–WW–P–491a
cast-iron water	F. S.–WW–P–421
	A. S. T. M.–A–44
clay sewer	F. S.–SS–P–361a
	A. S. T. M.–C–13
	A. S. T. M.–C–200
clay perforated	A. S. T. M.–C–211
	C. S.–143
concrete	F. S.–SS–P–371
concrete sewer	A. S. T. M.–C–14
concrete sewer, reinforced	A. S. T. M.–C–76
copper	F. S.–WW–P–377
	A. S. T. M.–B–42
laying sewer	A. S. T. M.–C–12
steel	A. S. T. M.–A–120
wrought iron	F. S.–WW–P–441a
	A. S. T. M.–A–72
Plaster, gypsum	F. S.–SS–P–402
	A. S. T. M.–C–28
Plaster-board, gypsum: see lath.	
Plastering, portland cement	A. S. A.–A42.3
sand for	A. S. T. M.–C–35
gypsum	A. S. A.–A42.1
Plywood (Douglas fir)	C. S.–45
western hemlock	C. S.–122
hardwood	C. S.–35
Plumbing:	
cast iron enameled ware	C. S.–77
earthenware (vitreous-glazed plumbing fixtures)	C. S.–4
	C. S.–20
	C. S.–111
formed metal fixtures	F. S.–WW–P–542
	C. S.–144
fixtures	F. S.–WW–P–541a
fixture-setting compound	F. S.–HH–C–536
plumbing manual	B. M. S.–66
Prepared masonry cement; see cement.	
Putty, wood sash glazing	F. S.–TT–P–791a
metal sash glazing	F. S.–TT–P–781a
Reinforcing steel; see steel.	
Roofing; also see shingles.	
Roofing, materials for built-up	U. L.–Roof Coverings
asphalt	F. S.–SS–A–666
asphalt primer	F. S.–SS–A–701
asphalt roofing, mineral surfaced	A. S. T. M.–D–249
asphalt-saturated asbestos felt	F. S.–HH–F–185
	A. S. T. M.–D–250.

Subject	*Source and specification number or volume*
Roofing, material for built-up. *Continued.*	
asphalt-saturated rag felt	F. S.–HH–F–191a U..L.–Subject 55 (B) A. S. T. M.–D-226
coal-tar-pitch	F. S.–R–P–381.
coal-tar-saturated felt	F. S.–HH–F–201 A. S. T. M.–D–227
Screening, insect wire	F. S.–RR–C–451a C. S.–138
insect plastic	F. S.–L–S–139
Sewers	A. P. W. A.–J
Shades, materials for	F. S.–DDD–S–251a
cloth for	F. S.–CCC–C–521a
Sheathing board, gypsum	F. S.–SS–S–276 A. S. T. M.–C–79
Sheet metal, galvanized	F. S.–QQ–I–716 A. S. T. M.–A–93.
tinned	F. S.–QQ–I–706a
Shingles, asbestos-cement	F. S.–SS–S–291b A. S. T. M.–C–222
asphalt, mineral surfaced	F. S.–SS–R–521 A. S. T. M.–D–225
slate	F. S.–SS–S–451
wood	C. S.–31
Siding, asbestos-cement	F. S.–SS–S–346a A. S. T. M.–C–223
Slag; see aggregates, concrete.	
Sound insulation	B. M. S.–17
Stairs, hardwood treads and risers	C. S.–89
Steel, design, fabrication and erection	A. I. S. C. Code of Standard Practice
structural	F. S.–QQ–S–741 A. S. T. M.–A–7
Steel reinforcing, bars	F. S.–QQ–B–71a A. S. T. M.–A–15 and A–16
cold-drawn wire	A. S. T. M.–A–82
welded wire fabric	A. S. T. M.–A–185
Stucco, portland cement	A. S. A.–A42.2
Thermal insulation; also see fiberboard.	
cotton batt	F. S.–HH–I–528
glass block	F. S.–HH–I–551
laminated-asbestos	F. S.–HH–I–561c
laminated felt for pipe	F. S.–HH–I–567
magnesia	F. S.–HH–I–61a
mineral wool	F. S.–HH–I–521c
mineral wool for heated surfaces:	
(soft)	F. S.–HH–I–563
(hard)	F. S.–HH–I–564

Subject	*Source and specification number or volume*
Thermal Insulation. *Continued.*	
redwood bark (shredded)	F. S.–LLL–I–533
vermiculite, block and pipe covering, molded	F. S.–HH–I–578a
wood fiber blanket	C. S.–160
Thermal insulation cement, mineral wool	F. S.–HH–C–168
Tile, clay for floor and walls (ceramic)	F. S.–SS–T–308
	SPR–R–61
drain	F. S.–SS–T–310
	A. S. T. M.–C–4
enameled iron	F. S.–RR–T–421a
floor, asphalt	F. S.–SS–T–306a
floor, asphalt, grease resistant	F. S.–SS–T–307
floor, cork	F. S.–LLL–T–431
floor, rubber	F. S.–ZZ–T–301a
floor, clay, structural	F. S.–SS–T–321
	A. S. T. M.–C–57
load-bearing clay	F. S.–SS–T–341a
	A. S. T. M.–C–34
non-load-bearing clay	F. S.–SS–T–351a
	A. S. T. M.–C–56
partition, gypsum	F. S.–SS–T–316
	A. S. T. M.–C–52
plastic	C. S.–168
Tin, roofing (terneplate)	F. S.–QQ–T–201a
Venetian blinds, wood slat	F. S.–LLL–B–441a
Grade A, Custom-made	C. S.–61
metal slat	F. S.–RR–B–446
Wallboard, composition	F. S.–UU–W–101a
gypsum	F. S.–SS–W–51a
	A. S. T. M.–C–36
Waterproofing, bituminous plastic for	F. S.–SS–C–153
asphalt for	F. S.–SS–A–666
	A. S. T. M.–D–449
asphalt-saturated rag felt	F. S.–HH–F–191a
	A. S. T. M.–D–226
bituminous grout for:	
(above ground)	A. S. T. M.–D–170
(below ground)	A. S. T. M.–D–171
coal-tar pitch for	F. S.–R–P–381
	A. S. T. M.–D–227
coal-tar saturated felt for	F. S.–HH–F–201
	A. S. T. M.–D–227
Water system, water mains	A. A.–7D.1; 7D.2
cast-iron water pipe	A. W. W. A.
wells	A. W. W. A.–4A.1
Windows, ponderosa pine	C. S.–163
Window units, double hung wood	C. S.–190
Wire fabric; see lath.	
Wood finish; also see lumber, stairs.	
hardwood interior	C. S.–76
Wood preservatives	F. S.–TT–W–571c
	A. W. P. A.
Wood siding, see lumber.	
Zinc	F. S.–QQ–Z–301a
	F. S.–QQ–Z–351a

General references	*Source and number or volume*
American Standard Building Code Requirements for Masonry.*	N. B. S.–M174
Building Code Requirements for New Dwelling Construction.*	B. M. S.–107
Fire Tests of Building Construction and Materials..	A. S. T. M.–E–119
How to Design and Build Precast Concrete Joist Concrete Floors.	P. C. A.
Light Frame House Construction*.....	F. S. A.
List of Inspected Fire-Protection Equipment and Materials.	U. L.
Minimum Standard Requirements for Precast Concrete Floor Units.	A. C. I.–711
National Building Code.....	N. B. F. U.
Open Web Steel Joist Construction.....	S. J. I.
Preventing Damage to Buildings by Subterranean Termites and Their Control, Farmers' Bulletin No. 1911.*	B. F. & P. Q.
Specification for the Design of Light Gage Steel Structural Members.	A. I. & S. I.
Wood Handbook*.....	F. P. L.

General heating references	*Source and number or volume*
Heating, Ventilating, and Air-Conditioning Engineers' Guide.	A. S. H. & V. E.
Measurements of Heat Losses From Slab Floors*....	B. M. S.–103
Directory of Approved Gas Appliances and Listed Accessories.	A. G. A.
List of Inspected Gas, Oil, and Miscellaneous Appliances.	U. L.
National Building Code.....	N. B. F. U.
Standards for the Installation of Oil-Burning Equipment.	N. B. F. U.–31
Standards for the Installation, Maintenance, and Use of Piping, Appliances, and Fittings for City Gas.	N. B. F. U.–54
Standards for Liquefied Petroleum Gases.....	N. B. F. U.–58
Standards for the Installation of Air-Conditioning, Warm-Air Heating, Air-Cooling, and Ventilating Systems.	N. B. F. U.–90
Standards for Small Heating and Cooking Appliances (kerosene and fuel oil).	N. B. F. U.–310

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General heating references	*Source and number or volume*
Gravity Code and Manual for the Design and Installation of Gravity Warm Air Heating Systems, Manual 5.	N. W. A. H. & A. C. A.
Code and Manual for the Design and Installation of Warm Air Winter Air Conditioning Systems, Manual 7.	N. W. A. H. & A. C. A.
Yardstick for the Evaluation of a Forced Warm Air Heating System, Manual 8.	N. W. A. H. & A. C. A.
A. S. M. E. Code for Low-Pressure Heating Boilers..	A. S. M. E.
Net Load Recommendations for Heating Boilers....	H. P. & A. C. C. N. A.
I–B–R Testing and Rating Code for Low-Pressure, Cast-Iron Heating Boilers.	I. B. R. M.
I–B–R Ratings for Cast-Iron Boilers.....	I. B. R. M.
I–B–R Installation Guide #100—One Pipe Forced Circulation Hot Water Heating Systems.	I. B. R. M.
I–B–R Installation Guide #2—One-Pipe Steam-Heating Systems.	I. B. R. M.
I–B–R Installation Guide #3—Selection and Installation of Indirect Water Heaters.	I. B. R. M
Steel Boiler Institute, Rating Code.....	S. B. I.
Automatic Mechanical Draft Oil Burners Designed for Domestic Installations.*	C. S.–75
Domestic Burners for Pennsylvania Anthracite (underfeed type).*	C. S.–48
Flue-Connected Oil-Burning Space Heaters Equipped With Vaporizing Pot-Type Burners.*	C. S.–101
Gas Floor Furnaces—Gravity Circulating Type*....	C. S.–99
Oil-Burning Floor Furnaces Equipped With Vaporizing Pot-Type Burners.*	C. S.–113
Solid-Fuel Burning Forced-Air Furnaces*.....	C. S.–109
Testing and Rating Convectors*.....	C. S.–140
Testing and Rating Hand-Fired Hot-Water Supply Boilers.*	C. S.–145
Warm-Air Furnaces Equipped With Vaporizing Pot-Type Burners.*	C. S.–104

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APPENDIX E

DETAILED HEATING REQUIREMENTS

The material under this heading is a part of the Heating Requirements, 500 through 503, compliance with which shall determine acceptability of heating equipment, and design and installation of heating systems. Any other method proposed, which, in the opinion of the Chief Underwriter, will result in installations which meet or exceed the performance requirements may be used.

SAFETY PROVISIONS

I–A. Mounting and Clearances. See 501–B.

1. Each house and water-heating unit listed or labeled by Underwriters Laboratories, Inc. or the American Gas Association shall be installed in accordance with the limiting conditions of such listing or labeling.

NOTE.—*See current Underwriters Laboratories List of "Inspected Gas, Oil, and Miscellaneous Appliances" and AGA "Directory of Approved Gas Appliances and Listed Accessories" for mounting instructions and minimum clearances.*

2. Equipment not listed or labeled by Underwriters Laboratories, Inc. or American Gas Association shall be installed in accordance with the applicable provisions in Appendix 1 of the current "National Building Code Recommended by the National Board of Fire Underwriters."

3. Construction below oil-fired units in basementless houses shall be protected from oil leakage or spillage by a metal pan in a manner acceptable to the Chief Underwriter.

4. All house and water-heating units shall be accessible for servicing and replacement without damage to structure.

5. Solid-fuel-burning, house-heating or water-heating units shall not be installed above the first floor.

HEAT LOSS CALCULATION

II–A. The maximum hourly heat loss for each heated space shall be calculated in accordance with the procedure described in the current edition of the "Guide" of the American Society of Heating and Ventilating Engineers or by any recognized method which is suitable to local conditions provided the results obtained are in substantial agreement with, and not less than those obtained by using the procedure described in the "Guide" of the ASHVE. Regardless of the method used, and for the purpose of simplifying the calculations, the following basic data shall be used:

1. The outside design temperature used in the calculation shall be that established by the FHA Insuring Office for the locality in which the dwelling is located.

2. The inside design temperature used in the calculations shall be not less than 70° F. except that a lower inside design temperature acceptable to

II – A. Heat Loss Calculation. *Continued.*

the Chief Underwriter may be used in calculating the heat loss from playrooms, laundry rooms, enclosed service porches, heated garages, and similar spaces.

3. The calculation of heat loss from heated spaces into adjacent spaces such as attics, basementless areas and heated or unheated garages shall be based on the assumption that the temperature of such adjacent spaces is the same as the outside design temperature.

4. All conventionally constructed floors over basements or other warmed spaces are assumed to have no heat loss into those spaces.

5. Transmission coefficients used in the calculation shall be those listed in the "Guide" or Federal Housing Administration Circular "Calculation of Building Section Heat Transmission Coefficients", or as established by tests acceptable to the Chief Underwriter.

6. Infiltration heat loss shall be calculated as the heat required to raise the temperature of an amount of air equal to the cubical contents of all the heated space in the dwelling from the outside design temperature to the inside design temperature in one hour (one air-change per hour).

7. Heat losses through concrete floor slabs on the ground shall be calculated in accordance with the perimeter method described in BMS Report No. 103 by the National Bureau of Standards. See II–B.

8. The reduction in heat loss effected by storm windows and doors specified and furnished shall be credited in the heat loss calculation.

II–B. Heat Loss Through Slab Floors on the Ground. The slab type of concrete floor laid on the ground presents an individual problem. Recent tests at the National Bureau of Standards indicate that slab floors laid on the ground lose heat principally from areas near the exposed edge. Although some heat is lost from other portions of the slab, the rate of loss decreases rapidly as the distance from the exposed edge increases. The conclusions drawn from the tests are that:

1. The heat loss through the floor is proportional to the exposed perimeter of the floor and to the total degree days occurring in the locality during the month preceding the date for which the calculation is made.

2. The use of stone, gravel, or cinders in a depth of several inches and a layer of tar paper or other material impervious to water, placed under the floor:

a. prevents the penetration of water.

b. insulates the floor sufficiently to permit the temperature of the floor to follow the temperature of the air above it and thus lessen the probability of condensation on the floor surface in summer.

3. The temperature variation on the floor surface is significant for only a short distance (4 feet or less) from the edge.

4. The use of an insulating strip at the edge or between the edge of the floor slab and the foundation wall materially lowers the edge heat loss, raises the floor surface temperature in the area near the edge and thereby improves the comfort conditions and lessens the probability of condensation on this portion of the floor surface in winter.

The foregoing tests and the conclusions derived therefrom indicate that the heat loss from slab floors on the ground can be determined easily and more accurately than by previously used methods, by a method employing the Perimeter Formula. This formula which follows shall be used for calculating the heat loss from slab floors on the ground.

$$H_f = F_1 \times P \times D_j,$$

in which

H_f = Total heat loss from slab floor (Btu per hour).

F_1 = Heat loss factor obtained from Building Materials and Structures Report, BMS 103 of the National Bureau of Standards. Typical factors range from 0.020 to 0.040.

P = Perimeter of floor in feet.

D_j = Average January degree days over a period of at least 5 years, as issued by the United States Weather Bureau.

ACCEPTABILITY OF HEATING SYSTEMS according to the heating medium and method of distribution

III–A. When the heating medium is hot water or steam circulated through a system of pipes connected to radiators, convectors or other heat exchanging devices:

1. Circulation may be by gravity when the top of the boiler is below the floor level of all first floor habitable spaces provided the system is designed in accordance with the requirements for gravity circulation hot water or steam systems, whichever is applicable.

2. Mechanical circulation shall be provided when the top of the boiler is above the first floor level, or when the boiler is below the first floor level and the system is not designed to operate by gravity circulation. The system shall be designed in accordance with the requirements for a forced circulation hot water system or mechanical condensate return system, whichever is applicable.

III–B. When the heating medium is warm air supplied to or returned from the spaces to be heated through a system of ducts:

1. Circulation may be by gravity when the top of the furnace is below the floor level of all first floor habitable spaces and the tops of all supply registers are within 18 inches of the floor provided the system is designed in accordance with the requirements for a gravity circulation warm air system.

III – B. Acceptability of Heating Systems. *Continued.*

2. Mechanical circulation shall be provided if the duct resistance due to limited size, length and turns will prevent adequate gravity circulation, if the top of any supply register is more than 18 inches from the floor, or if the top of any supply register is below the top of the furnace. The system shall be designed in accordance with the requirements for a forced circulation warm air system unless the system comes under the provisions of III–C.

III–C. If heated air is supplied by means of a device such as a space heater, floor furnace, wall heater, pipeless furnace or similar device the following requirements shall apply:

1. The distance center to center between a supply outlet and any space to be heated by it, measured through the center of intervening openings, shall not exceed 18 feet.

2. If the supply outlet and return inlet of the device are in the same space, there shall be no more than one doorway and one archway between the supply outlet and any space to be heated by it.

3. If the only supply outlet and the only return inlet of the device are not in the same space there shall be no more than one doorway and one archway between the supply outlet and any space to be heated by it and no more than one doorway and one archway between the supply outlet and the return inlet of the device. If there is a doorway between the supply outlet and the return inlet it shall have a fixed louvered opening with a net free area not less than 8 square inches per 1,000 B. t. u. gross output rating of the device.

4. If the principal supply outlet and the principal return inlet are not in the same space and if ductwork has been added to the device, there shall be no more than one doorway and one archway between a supply outlet and any room to be heated by it except where the kitchen is in the path of return air to the principal return inlet. Each door in path of air flow, between the principal supply outlet and the principal return inlet shall be provided with fixed louvered openings with the opening in each door having a net free area of not less than 8 square inches per 1,000 B. t. u. of gross output rating of the device.

5. The maximum hourly heat loss from the dwelling or that portion of the dwelling which one unit is intended to heat shall not exceed 45,000 B. t. u. This may be increased to 50,000 B. t. u. if an air circulating fan is incorporated in the unit.

6. If a fan is provided it shall have a quiet performance capacity as installed of not less than 10 cfm per 1,000 B. t. u. gross rated capacity of the device. A fan of insufficient capacity is indicated by an air temperature rise through a heater of more than 100° F. when the heater is fired at its maximum rating. Fan shall be so controlled that it will operate at all times when the air temperature at the device outlet is above 135° F. No means shall be

provided for manually breaking the fan electrical circuit. Except for quietness, this paragraph does not apply to free standing fan-equipped space heaters not installed in connection with ductwork.

7. If ductwork is added to the device but of insufficient extent for the system to be considered a conventional gravity or forced circulation system, the following additional requirements shall apply:

a. Ductwork installations shall comply with the provisions of National Board of Fire Underwriters Pamphlet No. 90.

b. Ductwork shall be connected to the device.

c. A fan complying with 6 above shall be provided if top of device is above floor level of any space to be heated by it, or if top of any outlet register is more than 18 inches above the floor.

d. A total net free area of not less than 8 square inches per 1,000 B. t. u. of gross output rating of the device shall be maintained throughout the supply system and also throughout the return system.

e. If more than one supply outlet is provided the net free area of the outlets and branch ducts shall be proportioned approximately in accordance with the heat losses of the portions of the dwelling they are intended to heat. Unless the bathroom is otherwise heated in a manner acceptable to the Chief Underwriter, a supply outlet shall be provided in the bathroom.

f. If device is coal fired or if manual control is used for other fuels, at least one-half of the branch supply duct area shall run untrapped from top of heater to unvalved outlet or outlets. Balancing dampers, if provided, shall not close more than 50 percent of the area of any duct.

III–D. No return air inlet shall be located in a bathroom, a room or space likely to be used for fuel or other storage, a confined space in which the combustion air intake is located such as the air intake of a gas- or oil-fired unit or the ash pit door of a coal-fired unit, or a confined space in which a draft diverter or draft regulator is located. A basement space shall not be used as a return plenum. A crawl space below first floor may be used as a return plenum provided the enclosing materials are not subject to decay or corrosion in the presence of moisture, the space is made tight against excessive air leakage and the ground is surfaced with at least 2 inches of concrete or other suitable material and the space is not designed to serve for storage.

CAPACITY OF HEATING EQUIPMENT

IV–A. The net outputs in B. t. u. per hour of radiators, convectors, registers, heat exchanges and heating surfaces shall be not less than the heat loss of the spaces which they heat and shall be proportioned so as to provide an acceptable uniformity of temperature throughout the dwelling.

For air heating devices net output shall be not less than the calculated heat loss of the spaces which it is intended to heat. For boilers net output shall

IV – A. Capacity of Heating Equipment. *Continued.*

be not less than the calculated heat loss of the spaces plus the prescribed allowance for attached domestic water heaters, if any. The manufacturer's published net output shall be used when it is less than the net output as defined below.

IV–B. The following definitions of ratings are applicable when the heating device or equipment is operated within the limits of the applicable code or rating procedure:

1. Input rating is the rated fuel consuming capacity of a heating device.
2. Gross output is the heat delivered in B. t. u. per hour:

a. In the air at the bonnet of a furnace or at the register of a floor, wall, or pipeless gravity furnace.

b. In the steam or water at the nozzle of a boiler.

c. At the discharge of an overflow heater.

3. Net output is the gross output less allowance for ordinary piping losses and pick-up.

PIPED DISTRIBUTION SYSTEMS

Systems consisting of boilers in which water is heated and pipes conducting hot water or steam to radiators or convectors shall comply with the following:

V–A. Boilers.

1. *Construction.* The construction of all hot water or steam heating boilers in which water is heated directly by the fuel and in which water is or may be subjected to pressures in excess of 5 lbs. per sq. in. and due solely to hydrostatic head of water shall be required to comply with the American Society of Mechanical Engineers' Code for Low Pressure Heating Boilers and each such boiler shall bear the symbol indicating compliance with A. S. M. E. Standards.

2. *Boiler Capacity.* Net boiler capacity shall be not less than the sum of all calculated loads and shall be as follows:

a. Hand fired or mechanically fired. The current Net Load Recommendation for Heating Boilers of the Heating, Piping and Air Conditioning Contractors National Association except that, where manufacturer's published or nameplate rating is less, the lower rating shall be used, or

b. Net load determined from certified test data submitted by the manufacturer to the Chief Underwriter and ruled by him as acceptable. Certified test data are to be substantially that required in the "I–B–R Testing and Rating Code" for cast iron boilers and the "S. B. I. Rating Code" for steel boilers.

c. Gas-fired boilers: 50 percent of the American Gas Assoc. input rating.

NOTE.—*For boilers supplying domestic hot water to living units add 6,000 B. t. u. for each living unit in excess of one.*

d. Boilers and boiler room equipment shall be so piped and valved as to be readily serviced and repaired. Electrical equipment shall not be installed beneath or adjacent to cleanouts of chimney or breeching.

e. All pumps shall be isolated by suitable connections to prevent transmission of vibration or noise.

3. *Trimmings and Firetools.*

a. Necessary firetools and cleaning brushes for properly maintaining the boiler shall be furnished.

b. Steam boilers shall be provided with safety valve, gauge glass and trycocks. Automatically fired steam boilers shall be provided with a low water cut-off supplied with the boiler by the boiler manufacturer.

c. Hot water heating boilers shall be equipped with an altitude or pressure gauge, thermometer, and, when connected to closed systems, shall be provided with a relief valve.

d. Boilers shall be connected to the house cold water supply with a shut-off valve and shall be provided with a drain cock suitable for connection with a hose for draining, or shall be piped to a drain.

4. *Insulation.* Boiler insulation shall be securely applied and shall be of thickness and insulating value adequate to prevent the overheating of living space. In no case shall the conductance of the insulating material plus any protective casing which may be used be greater than 0.50 B. t. u.

V–B. Pipe and Fittings.

1. All pipe for steam and hot water systems shall be steel, copper, brass or wrought iron and the ends shall be reamed full size.

2. Fittings shall be standard design and weight and of a material acceptable to the Chief Underwriter.

3. *Installation.*

a. Screw pipe and fittings shall be joined together with pipe compound applied to the pipe and not to the fitting.

b. Threads shall be clean and free from burrs.

c. All union connections shall be made so that there is no strain on the pipe and unions shall be accessible after the building is completed.

d. There shall be a ¾ inch drain valve at each low point of the system.

e. Piping passing through masonry walls shall be provided with sheet metal sleeves.

f. All supply piping and fittings of steam systems and all piping of hot water systems shall be insulated with material having an overall conductance of not more than 0.67 B. t. u.

g. All main piping shall be supported by suitable hangers located at least every 10 feet.

V–C. Radiators and Convectors.

1. Each radiator or convector shall be separately valved.
2. In addition each radiator or convector shall be provided with means of balancing the distribution of heat in the system. Balancing device may be integral with control valve but it shall be designed for locking in position and when so set shall not be affected by the operation of the control valve.
3. Enclosed unit shall be sized to compensate for effect of enclosure.
4. Top of radiators or outlet grilles: Maximum height above floor, 32 inches.
5. *Convectors.* Install in completely enclosing cabinets. Convector cabinets not of same manufacture as heating element shall have similar clearances around heating element, equally effective cabinet heights, and equivalent free areas of inlet and outlets, as cabinets with which the element was rated.
6. Insulate walls behind radiator recesses and recessed convector cabinets with material having an over-all conductance of not more than 0.67 B. t. u.

V–D. Hot Water System Design.

1. Design and install according to the recommendations in the current edition of the American Society of Heating & Ventilating Engineers "Guide". One-pipe Forced Circulation systems may be designed in accordance with the procedure described in steps 2 through 11 inclusive in "I–B–R Installation Guide No. 1."
2. The maximum temperature drop through each radiator shall be:
   a. 20° for forced circulation systems,
   b. 35° for gravity circulation systems.
3. Radiators and convectors shall be selected so that they deliver their required output at temperatures not in excess of
   a. 220° for fully automatically fired systems,
   b. 180° for manually fired systems.
4. Protect from excessive pressures and loss of water by:
   a. Open expansion tank with a visible overflow, all inside the building; or
   b. A closed tank equipped with a relief valve.
5. Install one-pipe mains dead level except when specifically directed otherwise by manufacturer of special one-pipe fittings used. Run supply mains in two-pipe systems with a pitch upward in the direction of water flow at least ¼ inch in 10 feet and return mains downward in the direction of water flow at least ¼ inch in 10 feet.
6. All branches to radiators shall pitch upward toward the radiator not less than ½ inch in 10 feet.
7. Install piping so that there are no air pockets in the system.
8. Provide accessible air valves and balancing fitting (see V–C–2) on all radiators and convectors and coils.
9. Provide an air chamber of not less than 6 cubic inches for each convector.

V–E. Steam System Design.

1. The design of steam systems shall be in accordance with the recommendations of the current "Guide" of the American Society of Heating & Ventilating Engineers.
2. Steam piping for one-pipe systems shall be sized in accordance with the following table:

Pipe Sizes for One-Pipe, Gravity, Low-Pressure Steam Heating System
Capacity in Square Feet of Equivalent Radiation

Pipe size (inches)	Supply main dripped, steam and condensate flow in same direction	Supply risers up-feed	Branches to supply risers and rads. not dripped *	Wet return main	Dry return main	Rad. valve sizes
¾	.....	25	.....	.....	.....	.....
1	56	45	28	.....	.....	28
1¼	122	98	62	1,200	670	62
1½	190	152	93	1,900	1,060	93
2	386	288	169	4,000	2,300	169
2½	635	464	260	6,700	3,800	.....

*Note.—*Radiator branches more than 8 feet in length shall be one size larger than shown. Minimum return pipe size 1¼ inches.*

3. Run main vertically full size of boiler tapping and pitch horizontal run down in direction of steam flow at least ¼ inch in 10 feet.
4. Take off undripped run-outs at 45 degrees from horizontal main and pitch upward in direction of steam flow at least 1 inch in 10 feet.
5. Provide automatic quick vent in the main, set vertically in a tee at least 2 feet beyond the last run-out on one-pipe systems.
6. Provide an adjustable air vent valve in each radiator in one-pipe systems.
7. Provide swing joints at the foot of all second floor risers.
8. Provide for balancing in one-pipe systems by means of adjustable air vent valves; in two-pipe systems by means of orifices or orificed supply valves.
9. Connect return pipe to boiler through a Hartford connection.
10. Equip automatically fired systems with low water cut-off supplied with the boiler by the boiler manufacturer.

DUCT DISTRIBUTION SYSTEMS

VI–A. Furnace Capacity.

1. *Gravity Furnaces.* Net register output rating in B. t. u. per hour shall be:
   a. For coal burning, hand fired:
      (1) With secondary heating surface of at least five times grate area and
         (a) With any ratio of total heating surface to grate area between

15 to 1 and 25 to 1 inclusive: not more than 1,785 times the heating surface in square feet.

(b) With a ratio of total heating surface to grate area greater than 25 to 1: not more than 1,785 x 25 x grate area in square feet.

(2) Without secondary heating surface or with secondary heating surface less than five times the grate area and with a ratio of total heating surface to grate area of at least 15 to 1: not more than that determined by multiplying the grate area in square inches by the factor opposite the applicable ratio in the following table:

Ratio	*Btu per sq. in. of grate area*	*Ratio*	*Btu per sq. in. of grate area*	*Ratio*	*Btu per sq. in. of grate area*
15–1	156	21–1	220	27–1	272
16–1	167	22–1	230	28–1	276
17–1	177	23–1	241	29–1	281
18–1	188	24–1	251	30–1	
19–1	198	25–1	262	and over	286
20–1	209	26–1	267		

b. For oil fired gravity furnace-burner units (any type burner): not more than 75 percent of the bonnet capacity determined in accordance with "Warm Air Furnaces Equipped with Vaporizing Pot Type Burners," Commercial Standard CS 104.

c. For gravity gas fired furnace units: not more than 75 percent of the AGA bonnet output rating.

d. For gravity furnaces with or without secondary surface, converted to automatic firing with stokers, oil burners, or conversion gas burners or for furnace-burner units for which adequate test data are not available: not more than the corresponding gravity coal-burning hand-fired rating.

2. *Forced Air Furnaces.* Net register output rating in B. t. u. per hour shall be:

a. For coal burning hand fired.

(1) With or without secondary heating surface and with any ratio of total heating surface to grate area: not more than 85 percent of the bonnet output rating determined in accordance with "Solid Fuel Burning Forced-Air Furnaces" Commercial Standard CS 109, or when such rating has not been determined,

(2) With secondary heating surface at least five times the grate area and

(a) With any ratio of total heating surface to grate area between 15 and 25 to 1 inclusive: not more than 2,265 times the heating surface in square feet.

(b) With a ratio of total heating surface to grate area greater than 25 to 1: not more than 2,265 x 25 x grate area in square feet.

(3) Without secondary heating surface or with secondary heating surface less than five times the grate area and with a ratio of total heating

surface to grate area of at least 15 to 1: not more than that determined by multiplying the grate area in square inches by the factor opposite the applicable ratio in the following table:

Ratio	*Btu per sq. in. of grate area*	*Ratio*	*Btu per sq. in. of grate area*	*Ratio*	*Btu per sq. in. of grate area*
15–1	198	21–1	278	26–1	338
16–1	211	22–1	292	27–1	344
17–1	225	23–1	305	28–1	350
18–1	238	24–1	319	29–1	356
19–1	252	25–1	332	30–1	
20–1	265			and over	362

b. For oil fired forced circulation furnace burner units (any type burner): not more than 85 percent of the bonnet capacity determined in accordance with "Warm Air Furnaces Equipped with Vaporizing Pot Type Burners", Commercial Standard CS104.

c. For forced circulation gas fired furnace units: 85 percent of the AGA bonnet output rating.

d. For forced circulation warm air furnaces converted to automatic firing with stokers, oil burners, or conversion gas burners or for furnace-burner units for which adequate test data are not available: not more than the corresponding forced air coal-burning hand-fired rating.

e. Heating surface and grate area shall be measured according to the current edition of the Codes and Manuals of the National Warm Air Heating and Air Conditioning Association. Secondary heating surface is heating surface so constructed and located that direct light of the fuel bed or burner does not shine upon any part of it.

f. Forced air furnace blower shall have a capacity in c. f. m. of not less than 1/75 of the maximum net output in Btu per hour of the furnace to which it is attached when the blower wheel is operating at a peripheral speed not greater than 1,600 fm and when the pressure in the bonnet is not less than 0.20 inches of water. The blower shall be built and installed in a manner which will assure continued quiet operation.

VI–B. Furnace Construction.

1. All cast iron warm air furnaces for gravity or forced warm air systems, except gas fired furnace-burner units, shall be constructed so that the minimum thickness at any point is not less than 1/4 inch and thickness at areas exposed to high temperature is not less than 3/8 inch. Gas fired furnace-burner units shall comply with the Approval Requirements, American Gas Association.

2. All steel furnaces shall be constructed with a minimum thickness of No. 14 U. S. S. gauge for secondary heating surfaces and No. 10 U. S. S. gauge for primary heating surfaces except for oil fired furnace-burner units which may be constructed in accordance with the requirements in "Warm Air

VI – B. Furnace Construction. *Continued.*

Furnaces Equipped with Vaporizing Pot-Type Burners" Commercial Standard CS–104 and for gas fired furnaces which shall comply with the Approval Requirements of the American Gas Association.

3. Heating surface on the suction side of the fan is acceptable only when:

a. Certified test data show that the temperature of the air measured at the inlet of the fan does not exceed 120° F. when the furnace is operating at its rated capacity.

b. In the absence of certified test data indicating compliance with (a) above, the actual measured area of such heating surface on the suction side of the fan shall not exceed 30 percent of the total heating surface.

c. Such surface is constructed of material not less durable than the minimum required by the applicable code or requirement for the construction of the primary heating surface of the combustion chamber section.

d. All joints between secondary and primary surfaces are welded or made with tight fitting bolted gasket external to that part of the furnace casing on the suction side of the fan.

e. The smokepipe extension, if any, is an integral part of the secondary surface and extends outside the casing and is constructed of material the same as the combustion chamber.

4. Casings shall be of incombustible material, tight fitting and securely fastened to the furnace so as to maintain proper clearances. A liner or insulation shall be applied to prevent the casing surface temperatures rising above 230° F. when operating at maximum rated capacity.

5. Filters shall not be exposed to direct radiant heat and shall be located so that the temperature of the filter is not raised by furnace heat more than 90° F. Filters shall not be installed in coal burning furnace installations.

VI–C. Furnace Installation—Forced or Gravity.

1. Locate gravity furnace so that lengths of supply ducts are as nearly equal as possible.

2. Joints between the bottom of the furnace and the foundation through which air may pass into the heating air stream shall be tightly sealed. The furnace parts shall be assembled plumb and level and joints requiring cement shall be well fitted.

3. Warm air furnaces which are fired by hand and equipped with a fan to circulate air shall be provided with an automatic damper regulator controlled by a room thermostat.

4. An air circulating fan connected to a warm air furnace shall be controlled by means of a temperature-actuated control located in the bonnet of the furnace or in the main supply duct near the furnace and shielded from radiated heat. This control shall cause the fan to operate at all times when the air in bonnet is above a predetermined temperature and shall be provided with a limit on the setting so that it cannot be set at a temperature

higher than 200°. Any other method of automatic control designed to accomplish the same result shall be submitted as a special method for consideration of acceptability. There shall be no manual disconnect switch in the fan electrical circuit.

5. Warm air furnaces which are automatically fired or are equipped with an automatic damper regulator shall be equipped with a temperature-actuated limit control, located in the bonnet of the furnace or in a main supply duct near the furnace and shielded from radiated heat. This control shall shut off or reduce the fuel supply to the oil burner, gas burner, or stoker, or cause the damper regulator to check the fire in the case of a hand fired installation, whenever the air temperature exceeds a predetermined setting (not higher than 250°), until the temperature has returned to a lower predetermined setting.

6. The controls required in 4 and 5 above may be combined in a single combination control.

VI–D. Duct Work Construction and Installation—Gravity and Forced Systems.

1. *General.* Comply with current Standards of the National Board of Fire Underwriters, Pamphlet No. 90. A combination of gravity and forced circulation of air is not acceptable. Use of propeller fan will not alter the requirements for a gravity system nor permit a reduction supply or return duct sizes.

2. *Supply and return ducts.*

a. All supply registers and return grilles shall be connected to the furnace or other heating unit by means of fittings or fittings and ducts which are closed, continuous and substantially air tight and throughout which the calculated required free area is maintained.

b. All fittings are to be of standard design without sharp turns and so fabricated and assembled that friction is minimized.

c. Slip joints shall provide at least 1 inch lap.

d. Calculated area of round duct shall be increased 10 percent to determine area of equivalent rectangular duct.

e. Calculated area of rectangular duct may be reduced 10 percent to determine area of equivalent round duct.

f. Duct fittings and connections shall be of sheet metal or other material acceptable to the Chief Underwriter.

3. Insulate all supply or return ducts in exterior walls, attacks and spaces under basementless houses with material having an over-all conductance of not more than 0.67 B. t. u.

4. *Supply ducts and registers.*

a. Supply duct area shall be determined as in E or F following, depending on whether forced or gravity system is used. Free area of register shall be not less than the calculated area of the respective supply duct.

b. Provide register valves in all bedroom and kitchen supply registers.

c. A means other than a register valve such as a splitter, turn, or stack-head damper shall be provided to control the air distribution to each supply register. When a splitter or turn damper is used, it shall have an accessible operating handle which indicates the position of the blade.

d. All supply ducts in warm air systems shall be constructed entirely of metal or other noncombustible material equivalent in structural strength and durability to the following:

(1) Ducts not enclosed in partitions:

Round Ducts

Diameter (inches)	*Minimum weight of tinned sheets per base box*	*Minimum thickness galv. iron U. S. gauge*	*Minimum thickness aluminum B & S gauge*
Less than 12	IC (107 lb.)	30	26
12 or more	IX (135 lb.)	28	26

Rectangular Ducts

Width (inches)	*Minimum thickness galv. iron U. S. gauge*	*Minimum thickness aluminum B & S gauge*
Less than 14	28	26
14 or more	26	24

(2) Ducts enclosed in partitions:

Width (inches)	*Minimum weight of tinned sheets per base box*	*Minimum thickness galv. iron U. S. gauge*	*Minimum thickness aluminum B & S gauge*
Less than 14	IC (107 lb.)	30	26
14 or more	IX (135 lb.)	28	26

(3) Cross-break top and bottom panels of all ducts 24 inches and wider.

NOTE.—*Tinned sheet ducts shall have a minimum coating of tin of 1.8 pounds per base box of 218 square feet. This corresponds to Class B coating in Federal Specification QQ–I–706–a.*

e. Any lining used in supply ducts shall be of fire-resistant material acceptable to the Chief Underwriter.

f. Joints and seams of all supply ducts shall be securely fastened and made substantially air tight; seams made with a drive cleat or Pittsburgh lock.

g. Supply ducts shall be securely supported by metal hangers, straps, or brackets. No nails shall be driven through the duct walls and no unnecessary holes shall be cut therein. When access or hand holes are cut they shall be provided with tightly fitted cover plates.

5. *Safety provisions relating to ducts.*

a. Supply ducts which run in the open, such as those which run approximately horizontal and near the ceiling, shall have clearances as follows:

(1) From metal ducts to combustible materials, including wood lath and plaster: not less than one inch;

(2) From metal ducts to metal lath and plaster or other incombustible finish attached to combustible material: not less than ¼ inch;

(3) For metal ducts covered with ½ inch or more of incombustible insulating material: no clearance required;

(4) From ducts made of asbestos-cement (or equivalent) to combustible material: one-half that specified for metal ducts.

b. Supply ducts which pass through combustible floor or ceiling shall:

(1) Clear such construction by at least 5/16 inch, or

(2) Be of double wall construction with a continuous air space of not less than 5/16 inch between the inner and outer walls and any remaining space around the duct filled with incombustible material.

c. Supply ducts enclosed in combustible floor, wall or ceiling shall:

(1) Clear combustible construction by 5/16 inch, or

(2) Be of double wall construction with a continuous air space of not less than 5/16 inch between the inner and outer walls, or

(3) Be insulated with incombustible material having a conductance of not more than 0.67 B. t. u.

d. Where supply ducts are located in closets and similar spaces, they shall be insulated with incombustible material having an overall conductance of not more than 0.67 B. t. u. and shall be protected against mechanical damage.

e. Where installation of supply ducts in walls, floors or ceilings requires the removal of fire-stopping the spaces around the ducts where such fire-stopping was removed shall be tightly filled with incombustible insulating material having an overall conductance of not more than 0.67 B. t. u.

f. Where registers are installed in the floors or walls of combustible construction, the register box shall clear the construction by not less than 5/16 inch.

g. Pipeless furnace-registers shall be installed in a register box constructed with an air space of not less than 4 inches between it and combustible construction except when the warm air passage is surrounded by a cold air passage.

h. Warm air systems using coal as fuel shall be protected against hazards due to overheating by the following:

(1) Omit filters.

(2) Omit register valves from registers supplying living room and bath.

(3) Arrange each balancing damper so that it cannot reduce by more than 50 percent the air flow through the duct in which it is installed.

6. *Return ducts and grilles.*

a. Return inlets shall be provided in such number and locations that air being returned from each habitable room in which there is no return inlet can enter a return inlet without passing across the floor of the normally occupied portions of living rooms or dining areas or traversing any portion

of the other habitable rooms. Air moving toward a return inlet located in or near the ceiling shall not be considered to be passing across the floor.

b. Free area of return: not less than calculated leader pipe or trunk area. See VI–D–2.

c. Returns from bathrooms or garages are not acceptable.

d. Provide register valve for each return opening located in bedroom or kitchen.

e. Return ducts or grilles serving one living unit shall not be connected with those serving any other living unit nor shall air returned from one living unit be re-circulated to any other living unit. Public halls shall not be used as a return plenum chamber.

f. Structural spaces may serve as return ducts provided such spaces are substantially air tight or are made tight with heavy asbestos paper tightly secured to the framing members. The sides of the framing members need not be covered except as required in VI–D–6–g. Joist spaces may be closed for this purpose with metal, dense composition board, cement-asbestos board, or other similar rigid material acceptable to the Chief Underwriter.

g. Incombustible material shall be used in the construction of return ducts, and for complete lining of structural spaces used as return ducts in the following locations:

(1) Within 2 feet, by shortest measurement, of casing, supply plenum, smoke pipe or vent, of any heater.

(2) For a vertical return duct located at the heater, and, in addition, the portion of a horizontal duct or joist space for a distance of 2 feet from the near edge of the connection of this horizontal duct or joist space with the vertical duct.

(3) Where a fire hazard may exist in ducts due to particles dropped through a register or heater, such as directly under floor registers or return grilles, at the bottom of vertical ducts, or directly under heaters having a bottom return.

VI–E. Design of Gravity Circulation Warm Air Systems. *See also VI–D.*

1. *General.*

a. Design and install according to the current edition of the "Gravity Code and Manual" of the National Warm Air Heating and Air Conditioning Association except where specifically provided otherwise in this appendix.

b. For Heat Loss Calculation see II–A.

2. Run separate duct from furnace to each register except that one supply duct may serve two outlets provided:

a. Both outlets discharge at the same level.

b. The horizontal runs from the top of the vertical duct to each register are approximately equal in length and neither is more than 3 feet.

c. Suitable means other than the register valves are provided for proportioning flow to each outlet.

d. Vision through the ducts between rooms is made impossible.

e. The capacity of the combined duct is not less than the sum of the requirements for the spaces served.

f. None of the following room combinations is served:

(1) Bathroom and any other room

(2) Living room and bedroom

(3) Living room and kitchen

(4) Any other combination which, in the opinion of the Chief Underwriter, is unacceptable.

g. A design adequately described and shown in a detailed drawing is submitted and accepted by the Chief Underwriter before installation.

3. Area of leaders and stacks shall be determined in accordance with:

a. The "Gravity Code and Manual" of the National Warm Air Heating and Air Conditioning Association, or

b. The following formulae and limitations:

(1) First story baseboard or floor registers:

$$\text{Round leader pipe area in sq. in.} = \frac{\text{B. t. u. hourly heat loss}}{130-4E-1.5L}$$

(2) For second story baseboard registers:

$$\text{Rectangular wall stack area in sq. in.} = \frac{\text{B. t. u. hourly heat loss}}{283-13E-3L}$$

Round leader pipe area = 150 percent of calculated wall stack area.

Rectangular leader pipe area = 165 percent of calculated wall stack area.

in which:

L = total equivalent feet of run as follows:

Each foot of leader pipe from furnace to boot = $1L$

Each foot of horizontal duct at other than basement level:

Area not less than calculated stack area = $1.5L$

Area not less than calculated leader pipe area = $1L$

E = number of equivalent elbows as follows:

Each direction change occurring in horizontal or vertical run between furnace and register box shall be considered as its equivalent E value as follows:

Each direction change greater than 45° and not greater than 90° = $1E$

Each direction change greater than 30° and not greater than 45° = $0.5E$

Each direction change greater than 15° and not greater than 30° = $0.25E$

Direction changes less than 15° shall be disregarded.

(3) Minimum leader pipe size: 6 inches diameter round or equivalent.

(4) Minimum stack area: 26 square inches with minimum depth of 2½ inches and a width not over 6 times the depth used.

VI–F. Design of Forced Circulation Warm Air Systems. *See also VI–D*

1. *General.*

a. Design and install in accordance with the "Code and Manual for the Design and Installation of Warm Air Winter Air Conditioning Systems" of the National Warm Air Heating and Air Conditioning Association, except as otherwise provided in this Appendix.

b. For Heat Loss Calculation see II–A.

c. As a guide, use "Yardstick for Classifying Warm Air Winter Air Conditioning Systems" as published by the N. W. A. H. A. C. A.

NOTE.—*Class C in Yardstick will not be acceptable. Materials other than those covered in paragraphs 310 and 311 of the "Yardstick" may be used provided they are acceptable to the Chief Underwriter.*

d. Use of propeller fan requires compliance with requirements for gravity warm air systems. No reduction in duct sizes will be permitted.

2. *Supply and return ducts.*

a. Connect to heater with flexible joint of fireproof material.

b. Air velocities in feet per minute for supply and return shall not exceed 750 in trunk, 600 in branches, and 500 in stacks.

c. Area of rectangular supply ducts shall be in accordance with "Code and Manual for the Design and Installation of Warm Air Winter Air Conditioning Systems."

d. A fresh air intake with an area not less than 20 percent of total required return area shall be provided which shall be insect-screened and protected from the weather and separately connected to the return air plenum through a tight and continuous duct fitted with an accessible tight damper adjustable to all positions from wide open to closed. No reduction in return grille or duct area shall be made because of the use of the cold air intake.

e. Each trunk duct connection shall be made to the sides of the plenum with a transition fitting. The area of the fitting at the intersection with the plenum shall be not less than 1½ times the trunk duct area and the center line of the transition fitting shall be not more than 45 degrees from the horizontal.

f. All changes of direction in trunk, branch and risers shall be made with fittings with an internal radius of not less than 2 inches or properly designed turning vanes shall be used in the fittings.

g. Trunk take-off connections shall be made so that the angle between the center line of the take-off and the center line of the duct is 45 degrees or less.

3. Run a separate riser to each register except that one supply riser may serve two outlets provided:

a. Both outlets discharge at the same level.

b. Suitable means other than the register valves are provided for proportioning flow to each outlet.

c. Vision through the ducts between rooms is made impossible.

d. The capacity of the combined duct is not less than the sum of the requirements for the spaces served.

e. None of the following room combinations is served:

(1) Bathroom and any other room.

(2) Living room and bedroom.

(3) Living room and kitchen.

(4) Any other combination which, in the opinion of the Chief Underwriter, is unacceptable.

f. A design adequately described and shown in a detailed drawing is submitted and accepted by the Chief Underwriter before installation.

4. Top of supply registers in walls shall be not more than 7 feet above the floor.

VI–G. Plenum Systems.

1. Design and installation shall be as required for forced circulation warm air systems. Top of supply registers in walls shall be not closer to the ceiling than 2 inches.

2. *Supply Plenum.*

a. Use material acceptable to the Chief Underwriter with all joints sealed air-tight.

b. Install register collars not less than 6 inches long, with accessible damper.

3. *Return Plenum.*

a. Crawl space under first floor is acceptable as a return plenum provided the surrounding wall construction is tight, the enclosing structural materials are such that they will not rot or corrode in the presence of moisture, and the ground is surfaced with at least 2 inches of concrete.

b. Basement space is not acceptable as a return plenum.

OVERFLOW HEATERS

VII–A. General. *See III–A.*

VII–B. Space Heaters.

1. *Coal Fired.*

a. Construction.

(1) Coal fired space heaters shall be constructed of cast iron or steel or both. Minimum thickness of cast iron combustion chamber sections or parts in direct contact with flue gases shall be not less than ¼ inch. Minimum thickness of steel combustion chamber or parts in contact with flue gases shall be not less than No. 10 U. S. S. gauge. Steel combustion chamber shall be lined with a minimum thickness of 1 inch of refractory material.

(2) Grates shall be constructed of cast iron and arranged so that they shall not be dislodged during the shaking or dumping operation.

VIII – B. Space Heaters. *Continued.*

(3) All doors and access openings into the firebox, ashpit, or gas passages shall be provided with paper-tight joints. All handles for doors and dampers shall be designed so as to minimize the danger of burns from personal contact. . The firedoor of surface fired heaters shall be protected from the heat of combustion by a suitable liner.

(4) Outside metal surfaces of heaters, grilles, jackets and accessories shall be protected against rust or corrosion.

b. Rating. The maximum and minimum ratings shall be determined in accordance with Tentative Standard for Coal Burning Space Heaters TS–3443, except that the indirect efficiency need not be more than 45 percent.

2. *Oil Fired.*

a. Construction and Rating shall be in accordance with the requirements of Commercial Standard CS–101 "Flue-Connected Oil-Burning Space Heaters Equipped with Vaporizing Pot-Type Burners." See also IX–B.

b. Installation: See III.

3. *Gas Fired.*

a. Construction and Rating shall be in accordance with the American Standards Association Approval Requirements for Gas Space Heaters published by the American Gas Association. See also VIII–A and B.

b. Installation: See III.

VII–C. Floor Furnaces.

1. *General.*

a. Placement. Locate so that no door, drapery, or similar object can be nearer than 12 inches to any portion of the floor furnace or register.

b. Installation: In accordance with CS–99.

(1) Bracing. The floor around the furnace shall be braced and headed with a framework of material not lighter than the joists. The inside dimensions of the framework shall be approximately ½ inch longer and wider than the furnace to be installed.

(2) Support. Means shall be provided to support the furnace when the floor grille is removed.

(3) Clearance. The bottom of the floor furnace shall have at least a 6-inch clearance from the ground, obtained, when necessary, by excavating the ground below and to the sides to form a "basin-like" pit under the furnace so that there is a 6-inch clearance beneath the furnace and a 12-inch clearance on all sides, except the control side, which shall have an 18-inch clearance. This facilitates any servicing that may be required and allows ample air for proper combustion.

(4) Seepage pan. Whenever the excavation exceeds 12 inches or water seepage is apparent under the house, a water-tight copper pan, concrete pit, or other suitable material shall be used. A copper pan shall be made of not less than 16 oz. sheet copper. The pan shall extend at least

4 inches above the ground level, with 12-inch clearance from the furnace on all sides except the control side, which shall have 18-inch clearance.

(5) Access. Adequate provision shall be made for easy access to the furnace under the house by means of an opening in the foundation wall or through a trap door of at least 18 x 24 inches, located at some convenient point in the house, and a clear unobstructed passageway to the furnace at least 24 inches high by 24 inches wide. The local utility should be consulted with reference to the access facilities for servicing where it provides service.

(6) Appliance alterations. All gas floor furnaces, including those having single- or dual-wall register outlets, shall be installed without alterations, extentions, or changes of any kind in the furnace.

(7) Upper-floor installations. Gas floor furnaces may be installed in an upper floor, provided the furnace assembly projects below into a utility room, closet, garage, or similar nonhabitable space. In such installations, the furnace shall be enclosed completely, with means for air intake to meet the requirements of Commercial Standard CS–99, with provisions for service, with furnace clearance of 6 inches on all sides and bottom, and with the enclosure constructed of portland cement plaster on metal lath or material of equal fire resistance.

(8) Adjustment. All gas floor furnaces except those using liquefied petroleum gases shall be equipped with a gas-pressure regulator, which shall be adjusted and sealed so that the gas input does not exceed the approved input rating.

2. *Oil Fired.* Construction and Rating shall be in accordance with the Requirements of Commercial Standard CS–113 "Oil Burning Floor Furnaces Equipped with Vaporizing Pot-Type Burners."

3. *Gas Fired.* Construction and Rating shall comply with the American Standard Association Approval Requirements for Central Gas Heating Appliances Z–21–13, published by the American Gas Association. See VIII–A and B.

VII–D. Pipeless Furnaces.

1. *General.*

a. Placement. Locate so that no door, drapery, or similar object can be nearer than 12 inches to any portion of the floor furnace or register.

b. Installation. See VI–C.

GAS-BURNING EQUIPMENT

VIII–A. All gas burning equipment shall comply with Standards of the American Gas Association and evidence of such compliance shall be:

1. Seal of the American Gas Association, or
2. Manufacturer's certification of compliance.

NOTE.—*The approval of the local utility company may also be required.*

VIII–B. A. G. A. ratings are determined for installation at sea level. The output rating is to be reduced 5 percent for each 1,000 feet above sea level.

VIII–C. Gas piping shall be installed so as to provide a supply of gas sufficient to meet the maximum demand due to simultaneous operation of all gas burning appliances installed. The maximum demand is the sum of the input ratings of all appliances served. The piping is to be sized according to the following tables:

Capacity of Pipe in Cubic Feet per Hour

Iron pipe diameter	*Lenght of pipe*	
	15 ft.	*30 ft.*
½	76	52
¾	172	120
1	345	241
1¼	750	535
1½	1,220	850

Typical Demand of Common Appliances

Appliance:	*Btu per hour*
Range	62, 500
Water heater	25, 000
Instantaneous water heater per gpm	37, 500
Room heater	15, 000
Refrigerator	2, 000
House heater	1.40 x house heat loss

VIII–D. Pipe and fittings shall be steel, wrought iron or wrought steel or other materials acceptable to the Chief Underwriter.

VIII–E. Piping shall not be run on or in outside walls. A drip, in which liquid condensate may collect and from which it may be removed shall be provided at any point in the piping where condensate will collect. Drips should not be located where the condensate is likely to freeze.

VIII–F. A tee fitting with the bottom outlet plugged or fitted with short nipple and cap shall be used at the bottom of all risers and drops.

VIII–G. Piping shall not be installed within any air ducts.

VIII–H. Locate meter in accessible and unconfined space and support rigidly.

VIII–I. White lead or other joint compound shall be applied sparingly to the male threads only. In the case of liquefied petroleum gases (propane, butane or butane-air gases) the compounds used in making up joints shall be resistant to the action of such gases.

VIII–J. All branch outlet pipes shall be taken from the top or sides of main lines above the center line.

VIII–K. All connections shall be free from strain.

OIL-BURNING EQUIPMENT

IX–A. Mechanical Draft Oil Burners shall comply with the requirement of Commercial Standard CS–75 and evidence of such compliance shall be:
1. Label of the Underwriters' Laboratories specifying that the burner complies with CS–75.
2. Certificate posted on the installation in accordance with CS–75.
3. The firing rate at which the burner is set shall be within the firing range for which the burner has received Underwriters' CS–75 approval (see list of Inspected Gas, Oil and Miscellaneous Appliances), and not more than the firing rate designated on the boiler, furnace, or unit, or as may be designated by the FHA field office. (This requirement supersedes the firing rate requirements, Article 25 (4) of CS–75.)

NOTE.—*An oil burner to which air for combustion is supplied by a power-driven fan is to be considered as a Mechanical Draft Oil Burner.*

IX–B. Natural Draft Oil Burners shall comply with the requirements of the Underwriters' Laboratories and evidence of such compliance shall be:
1. Label of the Underwriters' Laboratories, Inc.
2. *Pot-type burners.*
   a. Minimum chimney height, 18 feet above burner.
   b. Maximum length of smoke pipe measured horizontally, 3 feet.
   c. Permissible number of 90° smoke pipe elbows, not more than two.

NOTE.—*When acceptable to the Chief Underwriter, 2 above may be modified, provided suitable tests on a completed installation indicate adequate draft, meeting the requirements of the Underwriters' Laboratories for the equipment installed.*

IX–C. Installation of tank, piping, controls and burner shall comply with the following:
1. *Gravity Feed to Burners.*

a. Gravity feed shall be used only with burners arranged to prevent abnormal discharge of oil at the burner by automatic means specifically approved for the burner with which it is used.

b. Gravity supply tanks shall not exceed 275 gallons individual capacity. Where more than one gravity supply tank is used, such tanks shall be connected to the feed pipe leading to the burner through a manually operated, approved three-way valve in such a way that only one tank can discharge its contents at a time.

c. Where oil is supplied to the burner by gravity and a constant level device is not incorporated in the burner assembly or in an auxiliary tank used in connection with an automatic pump, an approved constant level device shall be installed in the oil feed line at the gravity tank or as close

thereto as practicable, to insure uniform delivery of oil to the burner. The vent opening of such constant level device shall be connected by piping or tubing to the gravity tank vent pipe.

2. *Installation of Underground Tanks.*

a. Oil supply tanks should preferably be located outside of buildings and underground with top of tank below the level of all piping to which the tank is connected, to prevent discharge of oil through a broken pipe or connection by syphoning.

b. Underground tanks shall be so buried as to have a cover of earth not less than 2 feet thick, or shall be covered with not less than 1 foot of earth on top of which shall be placed a slab of reinforced concrete not less than 4 inches thick. The slab shall be set on a firm, well tamped earth foundation and shall extend at least 1 foot beyond the tank in all directions. Where tanks are buried underneath buildings such a concrete slab shall be provided in every instance.

3. *Installation of Tanks Inside Buildings.*

a. Oil supply tanks larger than 60 gallons capacity shall not be located in buildings above the cellar or basement or above the lowest story of a basementless dwelling.

b. Unenclosed inside storage tanks and auxiliary tanks shall not be located within 7 feet, horizontally, of any fire or flame.

c. Oil supply tanks located inside buildings shall not exceed 275 gallons individual capacity or 550 gallons aggregate capacity.

4. *Installation of Outside Tanks above ground.* Tanks shall be enclosed in a manner which is acceptable to the Chief Underwriter.

5. *Setting of Tanks.*

a. Underground tanks shall be set on a firm foundation and surrounded with soft earth or sand well tamped in place. Where necessary to prevent floating they shall be securely anchored or weighted.

b. Inside storage and auxiliary tanks shall be securely supported by substantial incombustible supports to prevent settling, sliding or lifting.

c. Inside storage tanks shall be installed with the bottom pitched to the draw-off or drain opening with a slope of not less than ¼-inch per foot of length. The draw-off or the drain openings shall be provided with suitable piping connections in a form to provide a sump from which water or sediment can be readily drained at regular intervals.

d. Outside above ground tanks shall be set on a firm foundation. Those more than one foot above the ground shall have supports of masonry or protected steel, except that wooden cushions may be used. No combustible material shall be stored under or within 10 feet of outside above ground tanks.

6. *Construction and Coating of Tanks.*

a. Oil supply tanks shall be constructed of steel or wrought iron. The minimum gauge (U. S. Standard) shall be in accordance with the following table:

Capacity, gallons	*Underground and masonry enclosed inside tanks*	*Inside tanks*	*Outside above ground tanks*
1 to 60.....	16	16	18
61 to 180.....	16	16	16
181 to 275.....	16	14	16
276 to 285.....	16		16
286 to 350.....	14		16
351 to 560.....	14		14
561 to 1,100...	12		12

b. Oil supply tanks shall have an exterior coating as follows, or a suitable equivalent:

Underground tanks—Two coats of asphaltum.

Masonry enclosed inside tanks—One coat of asphaltum.

Inside tanks—Rust inhibiting paint.

Outside above ground tanks—Rust inhibiting paint.

7. *Tank Vents.*

a. Storage tanks shall be equipped with an open vent or an approved automatically operated vent, arranged to discharge to the open air. Vent openings and vent pipes shall be of ample size to prevent abnormal pressure in the tank during filling but not smaller than 1¼-inch pipe size.

NOTE.—*Where storage tanks are filled by the use of a pump through tight connections special consideration should be given to the size of the vent pipe to insure that it is adequate to prevent development of abnormal pressure in the tank during filling. This may be accomplished by use of a vent pipe commensurate in size with the discharge of the pump used or by means of a signaling or limiting device.*

b. Vent pipes shall be arranged to drain to the tank. The lower end of the vent pipe shall not extend through the top into the tank for a distance of more than 1 inch.

c. Vent pipes shall terminate outside of buildings at a point not less than 2 feet measured vertically or horizontally from any window or other building opening. Outer ends of vent pipes shall be provided with a weatherproof hood. Vent pipes should terminate sufficiently above the ground to prevent their being obstructed with snow and ice.

d. Vent pipes shall not be cross-connected with fill pipes or return lines from burners.

8. *Tank Fill and Overflow Pipes.* Storage tanks shall be filled through fill pipes terminating outside of any enclosing structure at a point at least 5 feet from any opening in the dwelling at the same or lower level. Fill terminals, when not in use, shall be closed tight by a metal cover designed to prevent tampering.

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IX – C. Oil-burning Equipment. *Continued.*

9. *Oil Gauging.*

a. All tanks in which a constant oil level is not maintained by an automatic pump shall be equipped with a method of determining the oil level.

b. Gauging devices such as liquid level indicators or signals, when provided, shall be installed so that oil or vapor will not be discharged into the building from the fuel supply system.

10. *Piping.*

a. All piping shall be standard full weight wrought iron, steel or brass pipe with standard fittings or brass or copper tubing and fittings.

b. Pipe used in the installation shall not be smaller than ¼-inch iron pipe size. Copper or brass tubing shall not be smaller in size than the equivalent of the iron pipe sizes mentioned above, with wall thickness not less than 0.049 inch.

c. Piping shall be rigidly secured in place and protected from injury in a workmanlike manner, and where necessary, shall be protected against corrosion. Where practicable, oil piping shall be buried underground or in a concrete floor.

d. Pipe joints and connections shall be made tight in a workmanlike manner. Unions and tubing fittings shall be of approved type. Unions requiring gaskets or packing, and right and left couplings, shall not be used in oil lines.

e. Proper allowance shall be made for expansion, contraction, jarring and vibration. Pipe lines, other than tubing, connected to underground tanks, except fill lines and test wells, shall be provided with double swing joints arranged to permit the tank to settle without impairing the efficiency of the pipe connections.

11. *Valves.* Readily accessible shut-off valves shall be installed in oil supply lines near each burner and close to supply tanks.

12. *Tests of Covered Tanks and Piping.* After installation and before being covered, underground or inaccessible tanks and piping shall be tested hydrostatically, or with equivalent air pressure, at a pressure not less than one and one-half times the maximum working pressure but not less than 5 pounds per square inch gauge at the highest point of the system. Instead of a pressure test, suction lines may be tested under a vacuum of not less than 20 inches of mercury. Tests should continue for at least 30 minutes without a noticeable drop in pressure or vacuum.

13. *Installation of the Burner.*

a. Oil burners shall be securely installed in a workmanlike manner, in accordance with the instructions of the manufacturer, by qualified mechanics experienced in making such installations.

b. The burner and combustion chamber shall be installed so that vapors will not accumulate in the portion of the furnace or boiler outside of and below the top of the combustion chamber.

COAL-BURNING EQUIPMENT, STOKERS

X–A. The capacity of a stoker shall be sufficient to develop the rated output of the equipment in which it is installed and the coal burning rate in lbs. per hour shall be not less than:

$$\frac{\text{Gross output of furnace or boiler}}{.60 \times C}$$

The minimum coal burning rate shall be not more than:

$$\frac{\text{Net Load on furnace or boiler}}{2.4\ C}$$

where C is the calorific value of the coal used.

X–B. The furnace dimensions shall be not less than shown in the following table:

Max. lbs. per hr.	*Setting height*	*Base height*	*Firebox width*	*Firebox length*	*Furnace volume*
15	17½	11½	16½	17	3
20	18	11¾	17¾	19	4
25	18½	12	19	21	5
30	19¼	12	20	23	6

For stokers designed to discharge ash by gravity into the ash pit the clearance between tuyere sides and furnace or boiler shall be not less than 2½ inches.

X–C. Stokers shall be provided with a hopper with a capacity not less than 15 times the maximum burning rate unless bin-feed. The charging edge of hoppers shall be not more than 48 inches above the charging floor.

X–D. Anthracite coal stokers shall be constructed and installed in accordance with the requirements of "Domestic Burners for Pennsylvania Anthracite (underfeed Type)", Commercial Standard CS–48.

X–E. Bituminous stokers shall be rated and installed in accordance with the recommendations of the Stoker Manufacturers' Association.

BREECHINGS, DAMPERS AND DRAFT CONTROLS

XI–A. General Requirements.

1. Smoke breechings shall have a free area not less than the smoke outlet of the connected appliance, shall be fitted with adequate clean-outs, and shall be constructed of iron or steel in weights not less than the following:

Diameter:	*Gauges*
to 12 in	24
12 in. to 16 in	20
16 in. to 20 in	18
20 in. to 30 in	16
over 30 in	14

2. Maximum length, 8 feet.

3. Pitch of breeching; upward toward chimney, 1 inch in 4 feet, minimum.

4. Provide acceptable thimble or special breeching connection in chimney.

XI–B. Provide the following dampers and draft controls in the breeching between the smoke outlet and the chimney connection.

1. *Coal-Burning Hand Fired.*

a. All equipment. Check damper and turn damper in breeching unless included as integral part of heating device. Turn damper shall have not less than 20 percent nor more than 25 percent free opening when in the closed position.

b. Furnaces and space heaters. In addition to the above an automatic draft regulator (barometic or equivalent) permanently set to limit the burning rate to the maximum acceptable rated output of the heater.

2. *Gas-Fired Equipment.* Draft diverter on outlet of heater. No turn damper permitted.

3. *Oil-fired and stoker-fired equipment.* Draft regulator (barometric type) listed by the Underwriters Laboratories, Inc.

XI–C. Design, Construction and Installation of dampers and regulators shall comply with Recommendations of National Board of Fire Underwriters.

INDEX

A

Acceptability of heating system ..... App. E-III
Acceptability of materials 401-F
Acceptability requirements, general 100
Acceptance, final 401-J
Access:
to attic 304-A
to basementless spaces 304-A
to dwelling 103-B
to living units 103-C
to plot 103-A
to storage space 302-C-6
Accessories, bathroom 602-C
Accessory buildings (*also see* Garage) ..... 106-B and D
Additional protection (termites) .. 409
Adhesives, floor 415-D
Aggregate 405-B
Alcoves, light and ventilation 301-D
Alley, definition ..... App. B
Alley, adjoining yard 203-C
Allowable span tables ..... App. A
Anchors:
areaways 406-F-1
sill and plate 406-A-4
stud to masonry 408-F-7
terrace and porch slab 406-E-6
wood joist to masonry 408-C-3
Application of individual property ..... Foreword
Application of structural requirements 401-B
Area:
building 202-C
garage 310
rooms 302-C
lot 201-B
Areaways 304-A, 308
Asbestos cement:
roof shingles 411-D
siding 410-C
Asphalt:
dampproofing 406-E-3, 406-G, 406-I-5
felt ..... 406-E, 406-J-2, 408-I, 411, 412-E, 415-B and C, 419-B
fiber drain tile 406-D
shingles 411-B
tile floor 415-D
Attached garages 419-A
Attics:
access 304-A
joist sizes 408-D
light and ventilation 301-L
louvers 301-L
scuttle 304-A

B

Backfill, earth 403-A-4, 802-B
Balloon frame 408-F-1
Barriers, vapor 402-B
Basement:
bearing partitions .. 406-K-4, 408-F-8
ceiling height 305-B
floor slab 406-E-4
habitable rooms 303
light and ventilation 301, 303, 308
stairway 307
storage space 302-C-6
Basementless space:
access 304-A
clearance 403-B
drainage 403-B
light and ventilation 301-K
vents 301-K
Base flashing (masonry veneer) . 406-J-2
Bases and caps, column 407-C
Bathroom:
accessories 602-C
finish 414-C
fixtures, electric 703-B, 703-C
heaters (unvented natural gas) .. 501-B
light and ventilation 301-E
size 302-C-3
unacceptable arrangement 304-B
wainscot 414-C
Bath tub 602-A
Beams, steel 407-B
Bearing partition framing 408-F
Bearing partition, masonry 406-K
Bearing soil 403-A, 406-D-1
Bed under slab 406-E
Bedroom:
area 302-C-1
closet 302-C-4
privacy 304-B
Bevel siding 410-A
Board, lumber 408-A
Boilers, heating ..... App. E-V-A
Bolts (*see* anchors)
Bonding:
masonry 406-C-4
masonry veneer 406-J-2
area walls 406-F-1
pilasters 406-F-3
walls 406-C-4, 406-I-4
Bracing, corner 408-F-3
Breechings, general requirements ..... App. E-XI
Bridging:
flat roof joists 408-E-3
floor joist 408-C-3
Building area, definition ..... App. B
Building area 202-C
Building line, definition ..... App. B

Building material and equipment, standard ..... App. C
Building material and equipment, acceptability of 401–F
Building material, plumbing ..... See BMS 66 Manual
Building paper ..... 402–B–4, 406–D–3, 406–J–2, 408–I, 410–E–1, 411–B, 419–B.
Building planning requirements. Sec. 300
Built-in garages 202–C, 419–A
Built-up roofs 411–G, 412–E

C

Cabinets:
kitchen 302–C–5
linen 302–C–4
Calculation, heat loss ..... App. E–II
Carports (see garages)
Cantilevered Construction 408–C–3
Caulking 408–L
Ceiling fixtures, electric 703–B
Ceiling joist span tables ..... App. A
Ceiling:
framing 408–D
height 305–B
insulation 402–A
sloping height 302–B, 305–B
Cement 405–A
Cement-lime mortar 406–C
Cement finish floor (*also see* Concrete slab) 415–A
Ceramic tile:
floor 415–C
floor base for 408–C–4
walls 414–B
Cesspool, definition ..... App. B
Changes after commitment 200–D, 300–D
Changes after submission 401–E
Chases 406–I–9, 406–K–2
Check list of information desired with application 2–B
Chief Underwriter's optional requirements 200–C, 300–C, 401–B
Chimney:
flashing 412–G
flues and vents 406–L, 501–B–3, 503
footings 406–D–1, 406–L–2
foundations 406–F–1, 406–L–2
framing at 408–B–2
masonry 406–L
masonry caps 406–L–6
saddles 408–E–2
Cinder concrete block 405–E
Circuits, electric 703–A
Clean-out doors, chimney 406–L–7
Clearance:
at stairs 307–B
between subfloor and masonry walls 408–C–4
for heating equipment ..... 302–C–8, App. E–I–C
in basementless spaces 403–B
Closets:
bedroom 302–C–4
coat 302–C–4
linen 302–C–4
storage 302–C–6
Coal burning equipment ..... App. E–X
Coal storage bin 302–C–7
Codes:
electric 701–B
heating 501–B
local 203–B, 300–B, 401–C
plumbing 601–A
Cold air (return) ducts, gravity and forced ..... App. E–VI
Collar beams 408–E–2
Columns:
bases and caps, shims 407–C
footings 406–D–1
steel and cast iron 407
wood 408–C–1, 409–D–2
Community system:
definition ..... App. B
sewage disposal 605–B
water-supply 604–B
Common services and facilities 401–K
Compliance Inspection Requirements 10
Concrete Block 405–E
Concrete:
block aggregate 405–E
cap on masonry foundations. 406–F–1, 406–H–7, 409–C
curing 406–B–6
design 406–B, 406–D, 406–F–2
footings 406–D
forms 406–B–4, 406–F–2
foundations walls 406–F, 409–B
general 406–A, 406–B–1
lintels. 406–I–6 and 9, 406–K–4 and 5
materials 405
mix ..... 406–B–1 and 2, 406–F–2
piers and pilasters 406–F–3, 406–H
protection against weather 406–A–2, 406–D–1
reinforcing (*see* reinforcing).
termite protection 409–B, 409–C
work 406–B
Concrete slab on ground 406–E
Concrete walks 406–E–7, 806
Condensation:
vapor barriers 402–B
Construction:
concrete and masonry 405, 406
details, suggested 30
general 400, 401
steel 407
wood 408
Convectors and radiators, heating ..... App. E–V–C
Convenience outlets, electric 703
Conventional construction 401–H
Corbels 406–E–6
Corner bracing 408–F–3
Corner Construction 408–F–2
Cornerites 414–A–7
Court, definition ..... App B
Courts 207

Coverage, definition ..... App. B
Coverage, lot 202
Crawl space 403–B
Crickets 408–E–2, 412–G
Cripples 408–F–5
Cross-bridging 408–C–3, 408–E–3
Curtain walls 406–H–1

D

Damper, fireplace 406–M
Dampers (heating) ..... App. E–XI
Dampproofing 406–E–3, 406–G, 406–I–5, 417–A
Decorating 417
Deduction from building area 202–C
Defective conditions and non complying construction. 108, 16–A
Definitions ..... App. B
Deliveries 103–B
Depth, footings and foundations. 403–A
Detached garages, one-story 419–B
Details:
construction, suggested 30
exterior and interior, application requirements 2D, 2–E, 2–F
Disappearing stairs 304–A–1
Distance between buildings 208, 203–B, 206–A
Domestic hot water 601–A–4, 502
Doors:
exterior 306–A
flashing 412–B
framing 408–F–5, 408–G–2
interior 306–B
kitchen cabinet 302–C–5
light and ventilation 301–B
Double framing 408–C–3, 408–E–1, 408–F–5
Downspouts 413
Draft Controls, general ..... App. E–XI
Drain tile, footing 406–D–3
Drainage, basementless space .. 403–B–2
Drainage, lot 800, 801, 803, 805
Drainage, roof 413–D, 606
Drains, plumbing 406–E–4, 603–C
Drawings:
Heating, plumbing, electrical ... 2–C
individual sewage-disposal system 4
individual water-supply system 4
plans, elevations, details 2–C, 2–F
plot plans 2–B
Driveway, definition ..... App. B
Driveways:
concrete construction 406–E–7
general 804
location to side yards 206–E
Drop siding 410–A
Dry-wall, finish 414–D
Dry wells, definition ..... App. B
Dry wells 606
Duct work, construction and installation ..... App. E–VI
Duplex outlets, electric 703–B
Dwellings, definition ..... App. B
Dwellings, types eligible 104

E

Eave projection 413–D
Easement, definition ..... App. B
Electrical:
requirements ..... Sec. 700
service 107, 701
Elevations, exterior, application requirements 2–D
Eligible dwellings 104
End-row dwellings 104
Entrance platforms 309
Equipment:
acceptability 401–F
heating ..... App. E
standards ..... App. C
Excavation:
basementless spaces 403–B
depth 403–A
foundations 403–A
Existing construction, applicable requirements ..... Foreword
Expansion joints 406–E–7
Exterior doors 306–A
Exterior elevations, application requirements 2–D
Exterior masonry (*see* masonry)
Exterior painting 417–A
Exterior wall finish:
aluminum siding 401–H
asbestos-cement siding 410–C
asphalt insulating siding 401–H
masonry veneer 406–J
plywood 410–D
stucco 410–E
wood shingle 410–B
wood siding 410–A
Exterior wall framing 408–F
Exterior wood trim 410–F

F

Facilities 107, 401–K
electric 701–A
heating 501–A
Family, Definition ..... App. B
Felt, bituminous saturated ..... 406–E, 408–I, 411, 412–E, 415–B, 415–C, 419–B.
Fiberboard:
dry-wall finish 414–D
lath 414–A
wall sheathing 408–H, 408–I
waterproofed insulation 406–E–3
Fill under slab 406–E
Final acceptance 401–J
Finish (*see* exterior wall finish, interior wall finish, exterior wood trim, floors, wood finish)
Finish grading (*also see* grade line) 805
Fire brick 405–E, 406–M
Fireplaces:
ash dump 406–M–2
flue 406–L
hearth 406–M–4
lining 406–M–3
smoke chamber and damper. 406–M–1
Firestops 408–B–3

Fixtures:
electric ... 703–B
plumbing ... 602
Flashing:
chimney ... 412–G
intersections, stucco and other material ... 412–C
materials ... 412–A
openings ... 412–B
roof and wall or parapet intersections ... 412–E
terrace and porch slab ... 409–F, 412–F
valley ... 412–D
Flat roof framing ... 408–E–3
Flat roof ventilation ... 301–L
Floor:
cement ... 406–E, 415–A
ceramic tile ... 415–C
finish ... 415
finishing ... 417–A
framing ... 408–C
garage ... 406–E–5, 419–B–8
heater room ... 415–A–2
joists ... 408–C–3
plastic ... 401–H
rubber tile, asphalt tile and linoleum ... 415–D
wood, material and installation ... 415–B
wood subfloor ... 408–C–4
Floor furnaces ... App. E–VII–C
Floor insulation ... 402–A, 406–E–3, App. E–II–B
Floor joist span tables ... App. A
Floor plan, application req'ts ... 2–C
Flue:
lining ... 405–E, 406–L
size ... 503–A
Flues and vents, general ... 501–B, 503–C
Footings:
chimney ... 406–D, 406–F–1, 406–L
depth of ... 403–A
drain tile ... 406–D–3
forms ... 406–B–4
garage, detached ... 419–B
general ... 406–D
partition (slab on ground) ... 406–E–3
stepped ... 406–D–2
trenches for ... 403–A
Forced air furnaces ... App. E–I, III, VI
Forced circulation warm air heating ... App. E–VI
Forms, concrete ... 406–B–4
Foundation:
depth ... 403–A
walls ... 406–E–3, 406–F
vents ... 301–K
Frame, balloon ... 408–F–1
Framing:
at chimney ... 408–B–2
bearing partition ... 408–F
ceiling ... 408–D
exterior wall ... 408–F
fire stopping ... 408–B–3
floor ... 408–C
garage ... 419
general ... 408–B
Framing *Continued.*
into masonry ... 406–I–7 and 8, 406–K–4, 408–C–3
lumber ... 408–A
nonbearing partition ... 408–G
openings ... 408–F and G
recommended nailing ... 408–B–4
roof ... 408–E
wood ... 408
Freezing weather ... 406–A–2, 406–D–1
Front yards ... 203–D, 203–E, 204
Fuel:
delivery ... 103–B
limitations (flues and vents) ... 503–C
storage ... 302–C–7
Furnaces ... App. E–VI and VII
Furnace capacity:
Forced air ... App. E–VI–A
gravity ... App. E–VI–A
Furnace construction ... App. E–VI–B
Furnace installation ... App. E–VI–C
Furring ... 406–I–5, 408–H

G

Garage:
attached, built-in ... 419–A
concrete floor ... 406–E–5, 419
computing lot coverage ... 202–C
construction ... 419
location to side yard ... 206–D
size ... 310
storage space ... 302–C–6
Garbage removal ... 103–B
Gas burning equipment ... App. E–VIII
General acceptability requirements ... Section 100
General storage space ... 302–C–6
Girder pockets ... 406–F–4, 409–D
Girder:
bearing ... 406–I–7
steel ... 407
wood ... 408–C
Glass and glazing ... 416
Glass, light ... 301
Grade line, finish:
at areaways ... 304–A, 308
at foundation wall ... 406–F–1
at habitable basements ... 303–C
lot ... Sec. 800
Grading:
basementless spaces ... 403–B
rough and finish ... Sec. 800
Grading rules for lumber ... 408–A
Gravity circulation warm air heating ... App. E–VI–D and E
Gravity furnaces ... App. E–VI–C
Grilles, return air ... App. E–VI–D
Grout for sills and girders ... 408–F–4
Gross output (heat), definition ... App. E–IV–B
Grounds ... 408–F–5
Guard rail ... 307–B, 309–B, 806
Gutters ... 413
Gypsum board:
lath ... 414–A
sheathing ... 408–H
wallboard ... 414–D

H

Habitable rooms..... 105–C and D
access and privacy..... 304–B
basement..... 303
definition..... App. B
light and ventilation..... 301–C
size..... 302–C
Handrails..... 307–B
Hardware:
bathroom accessories..... 602–C
exterior..... 418–B
exterior doors..... 418–C
general..... 418–A
Headroom, stairs..... 307–B
Headroom, sloping ceilings..... 302–B, 305–B
Headers, span and size:
bearing partitions..... 408–F–5
nonbearing partitions..... 408–G–2
floor framing..... 408–C–3
roof framing..... 408–E–1
Hearth, fireplace..... 406–M
Heat design, installation and rating..... 501–D
Heat loss
circulation..... App. E–II–A and B
definition..... 501–C–Note
limitations..... 402–A
through slab floor on ground..... App. E–II–B
Heat test, operating and maintenance instructions..... 501–E
Heater clearance. 302–C–8, App. E–I–C
Heater foundations..... App. E–I–B
Heater room:
floors..... 415–A
ventilation..... 301–J
Heaters, bathroom..... 501–B
Heating:
requirements... 107, Sec. 500, App. E
space for..... 302–C–8
standards..... App. C
Heating equipment, clearance for..... App. E–1
Heating plan or lay-out, application requirements..... 2–C
Heating, special methods and systems..... 501–F
Hip rafters..... 408–E–2
Hot water:
detailed requirements..... 502
general..... 107, 502
heating boilers..... App. E–V–A
heating system design... App E–V–D
Hung ceiling..... 408–D–2

I

Improvements, lot..... 800, 806
Individual system:
compliance inspection..... 14–C–6
definition..... App. B
sewage-disposal..... 4, 605–B
water-system..... 4, 604–B
Ineligible property..... 106–D, 108
Information with application.... 1
Inner courts..... 207–C
Input rating, definition... App. E–IV–B
Inspection, compliance..... 10
Insulation, thermal:
general..... 402–A
slab on ground. 406–E–3, App. E–II–B
vapor barrier..... 402–B–5
Insulation, duct work.... App. E–VI–D
Interior doors..... 306–B
Interior frame walls:
bearing..... 408–F
nonbearing..... 408–G
Interior floors..... 415
Interior masonry walls..... 406–K
Interior painting and decorating.. 417–B
Interior wall and ceiling finish:
bathroom..... 414–C
ceramic tile..... 414–B
dry-wall..... 414–D
lath and plaster..... 414–A
wood trim..... 414–E
Intersections, flashing for:
chimney and roof..... 412–G
roof and wall or parapet..... 412–E
stucco and other material..... 412–C
terrace and porch slabs. 409–F, 412–F
Iron, structural..... 407
Irregular shaped courts..... 207–D
Interior wood trim..... 414–E

J

Jack rafters..... 408–E–2
Joints, mortar..... 406–C–3
Joists:
bearing on masonry..... 406–I–8, 406–K–4, 408–C–3
ceiling..... 408–D
floor..... 408–C–3
roof..... 408–E–3
span tables..... App. A

K

Kitchen sink..... 602–A
Kitchen storage and cabinets.. 302–C–5
Knee bracing..... 408–F–3

L

Laboratory tests..... 401–F
Landings..... 307–B
Landscaping..... 806
Lath:
expanded metal..... 410–E, 414–A–2
fiber board..... 414–A–5
gypsum board..... 414–A–6
insulating fiber board..... 414–A–5
welded wire fabric... 410–E, 414–A–4
wood..... 414–A–1
woven wire fabric.... 410–E, 414–A–3
Lathing..... 414–A–7
Laundries, light and ventilation. 301–H
Laundry trays..... 602–A
Lavatory..... 602–A
Leaders..... 413

Light and ventilation:
alcoves ... 301–D
attics ... 301–L
basements ... 301–G
basementless spaces ... 301–K
bathroom ... 301–E
habitable rooms ... 301–C
heater rooms ... 301–J
laundries ... 301–H
recreation rooms ... 301–H
utility rooms ... 301–I
Lime ... 405–D, 406–C, 410–E–2, 414–A–8
Linoleum:
base for ... 408–C–4
floors ... 415–D
Lintels:
exterior masonry walls ... 406–I–6, 9
interior masonry walls. 406–K–4 and 5
Living facilities, definition ... App. B
Living facilities ... 105, 107–A
Living unit, definition ... 105–C and D, App. B
Living units, number of ... 105
Local regulations (*see* regulations)
Location of
heating equipment ... App. E–1
Loss, heat ... 501–C, App. E
Lot, definition ... App. B
Lot:
areas ... 201
corner ... 203–D
coverage ... 202
drainage ... 803
improvements ... 800, 806
irregularly shaped ... 203–E
line walls ... 104–B, 406–K–3
Lot line, definition ... App. B
Louvers ... 301–L
Lumber ... 408

M

Manual, plumbing ... 601–A
Masonry chimneys (*see* chimneys)
Masonry materials ... 405
Masonry units ... 405–E
Masonry veneer:
minimum thickness ... 406–J–1
construction ... 406–J–2
Masonry work:
bonding ... 406–C–4
cavity wall construction ... 406–C–5
foundation walls ... 406–F
dampproofing ... 406–G, 406–I–5
exterior walls ... 406–I
garages ... 419–B
general ... 406–A
interior walls ... 406–K
joints ... 406–C–3
mortar ... 406–C–1
mortar uses ... 406–C–2
tie beams ... 406–I–10
waterproofing ... 417–A–6
Matched siding ... 410–A–5
Materials:
acceptable ... 401–F
electric ... 702
quality ... 400, 401–B, 401–F
standards ... App. C
Membrane vapor barrier ... 406–E–3
Metal:
bridging ... 408–C–3
downspouts ... 413
flashing (*see* flashing)
gutters ... 413
lath (*see* lath)
reinforcing (*see* reinforcing)
roofs ... 411–H
termite shields ... 409–D
Millwork:
exterior ... 410–F
interior ... 414–E
Minimum construction requirements ... Sec. 400
Minimum planning requirements ... Secs. 200 and 300
Minimum property requirements, application of ... Foreword
Mix, concrete ... 406–B–2, 406–F–2
Moisture, content:
finish lumber ... 410–A–1, 414–E
framing lumber ... 408–A–4
Mortar. 405, 406–A–4, 406–C, 408–E–1
Multifamily properties, applicable requirements ... Foreword

N

Nailing:
acceptable schedule ... 408–B
corner bracing ... 408–F–3
cross-bridgng ... 408–C–3
exterior wall finish ... 410
roofing ... 411–A, 411–H
subflooring ... 408–C–4
studs at masonry walls ... 408–F–6
wood finish floors ... 415–B
Neighborhood requirements and standards ... Foreword
Net output, definition ... App. E–IV–B
Nonbearing partitions;
masonry ... 406–K
(*also see* 406–E–3)
wood ... 408–G
Nonresidential use ... 106

O

Objectives:
basement rooms ... 303–A
ceiling height ... 305–A
compliance inspections ... 10
courts ... 207–A
coverage ... 202–A
distance between buildings ... 208–A
electric ... 700
heating ... 500
light ... 301–A
lot area ... 201–A
lot improvements ... 800

Objectives *Continued.*
plumbing ... 600
privacy ... 304–B
sanitation ... 600
space requirements ... 302–A
stairways ... 307–A
structural ... 400
ventilation ... 301–A
yards ... 203–A
Oil burning equipment ... App. E–IX
Oil tank, installation of ... 302–C–7, App. E–IX–C
Open spaces, continued assurance of ... 203–B
Openings:
bearing partitions and walls. 408–F–5
flashings ... 412–B
nonbearing partitions ... 408–G–2
Optional requirements ... 200–C, 300–C, 401–B, 409–G
Ordinances, local ... 200–B, 300–B, 401–C, 501–B, 601–A, 701–B
Outer courts ... 207–B
Outlets, electric ... 703–B
Outside fixtures ... 703–B
Overflow heaters ... App. E–VI

P

Painting:
cement floors ... 417–D
exterior ... 417–A
edges of flush siding ... 410–A–5
flashing ... 412–A, 417–A–5
gutters and downspouts. 413–B, 417–A
interior ... 417–B
metal ... 417–E
termite shields ... 409–D
wood floors ... 417–C
Panel (floor) heating ... 406–E–3
Paper (*see* building paper, sheathing, decorating).
Parge coat ... 406–G–2
Partitions:
basement bearing. 406–K–4, 408–F–8
bearing framing ... 408–F
masonry ... 406–K
nonbearing framing ... 408–G
on slab on ground ... 406–E–3
Party walls ... 104–B, 406–K–3
Perimeter duct heating ... 406–E–3
Perimeter insulation. App. E–II, 406–E–3
Pier footings ... 406–D
Piers ... 406–H
Pilaster ... 406–F–3
Pipes and fittings, heating ... App. E–V–B
Pipe recesses, masonry wall ... 406–I–9, 406–K–2
Piping, gas ... App. E–VIII
Piping, plumbing ... 603
Pipeless furnaces ... App. E–VII–D
Pitch of roof ... 411–A
Pitched roof framing ... 408–E
Placing concrete ... 406–B–5
Plans, application requirements ... 2–C
Planning requirements ... Sec. 200, 300
Planting ... 806
Plaster ... 414–A–8
Plaster grounds ... 408–F–5
Plat, definition ... App. B
Plate anchorage ... 406–A–4, 408–E
Plates, wood:
bearing walls and partitions. 408–F–6
garage ... 419–B
nonbearing partitions ... 408–G–3
Plates, steel ... 407–B
Platforms (entrance) ... 309
Plenum heating system ... App. E–VI–G
Plot, definition ... App. B
Plot, (*also see* lot) ... 102
Plot plan, application requirements ... 2–B
Plot planning requirements ... Sec. 200
Plumbing:
codes and regulations ... 601–A
fixtures ... 602
manual (BMS–66) ... 601–A
piping ... 603
sewage disposal ... 605
water supply ... 604
Plumbing lay-out, application requirements ... 2–C
Plywood:
exterior finish ... 410–D
interior finish ... 414–D
roof sheathing ... 408–J
subfloor ... 408–C–4
wall sheathing ... 408–H–2
Porch:
electric outlet ... 703–B
flashing ... 412–F
floor, concrete ... 406–E–6
railing ... 307–B–8, 309–B
roof slope ... 411–A
size ... 309–A
stringers ... 406–A–5
termite shield ... 409–F
Posts and Columns ... 408–C–1
Preservative treatment, wood ... 409–E
Privacy:
bathroom ... 304–B–3 and 4
bedroom ... 304–B–3
general ... 304–B–2
Property, definition ... App. B
Property line, definition ... App. B
Proposed construction, applicable requirements ... Foreword
Protection against termites ... 409
Protection of concrete or masonry work ... 406–A
Protection, wood treatment ... 409–E
Public system, definition ... App. B

R

Radiators and convectors, heating ... App. E–V–C
Radiator recesses ... 406–I–9
Rafter ... 408–E
Rafter plate anchorage ... 406–A–4
Rafter span tables ... App. A
Rafter ties ... 408–D, 408–E–2, 419–B

Railings.... 307–B–7, and 8, 309–B, 806
Rear yards..... 205
Recesses..... 406–I–9, 406–L–2
Recommended nailing schedule..... 408–B–4
Recreation rooms, light and ventilation..... 301–H
Reference standards..... App. C
Registers, heat, gravity, and forced air..... App. E–VI–D
Regulations:
electric..... 701–B
local..... 200–B, 300–B, 401–C
plumbing..... 601–A
reinforced concrete..... 406–B–1
sewage disposal..... 605–B
water supply..... 604
Reinforcing concrete:
slabs on ground..... 406–E–1
design..... 406–B–1
footings..... 406–D–1
foundation wall cap.. 406–F–1, 409–C
garage..... 419–B
material..... 406–B–3
Relief valve (domestic water).. 502–D
Requirements, drawings and specifications..... 2–A, 3–A
Required windows, definition... App. B, 301–B–2
Required windows (*see* windows):
Residential use..... 106
Return air ducts, gravity and forced air..... App. E–VI–D
Ribbon..... 408–F–1
Ridge boards..... 408–E–2
Rise, roof..... 411–A
Rise, step..... 307–B–4, 806
Roof:
covering..... 41I
chimney flashing..... 412–G
framing..... 408–E
Sheathing..... 408–J
valley flashing..... 412–D
wall flashing..... 412–E
water disposal..... 413–C
Rooms, definition..... App. B
Rooms:
basement..... 301, 303
habitable..... 105–C, 301–C, 303
light and ventilation..... 301
size..... 302
Rough grading..... 404, 802
Row dwellings..... 104
Rubber tile:
floor base for..... 408–C–4
floors..... 415–D
Rubble stone masonry..... 406–C–4, 406–F–2
Rustic siding..... 410–A–4

S

Safety, heating.. 501–B, 502–D, App. E
Sanitation..... 108, Sec. 600
Scratch coat..... 410–E, 414–A and B
Screens:
foundation vents..... 301–K
louvers, attic..... 301–L
window..... 311
Scuttle..... 408–D
Sections, applications requirements..... 2–E
Seeding..... 806
Seepage pit, definition..... App. B
Seepage pit..... 605–B–3, 606
Semi-detached dwellings..... 104
Septic tank, definition..... App. B
Septic tank..... 605–B–3
Services..... 107, 401–K
Sewage disposal..... 107, 605
Sewer, house..... 603–C
Shall, definition..... App. B
Sheathing:
board lumber..... 408–A
paper or felt... 406–J–2, 408–I, 419–B
roof..... 408–J
wall..... 408–H, 319–B
Shields, termite..... 409
Shims, column..... 407–C
Shims, wood..... 408–F–4
Shingles, roof..... 411
Shingles, side wall:
asbestos-cement..... 410–C
wood..... 410–B
Ship lap sheathing (*see* sheathing)
Ship lap siding..... 410–A–5
Should, definition..... App. B
Shower walls..... 414–C
Side yards..... 206
Siding:
asbestos-cement..... 410–C
plywood..... 410–D
wood..... 410–A
wood shingle..... 410–B
Sill construction, wood..... 408–F–4
Sill plate anchorage..... 406–A–4
Site conditions..... 101
Size:
attic vents..... 301–L
each living unit..... 302–B
footings..... 406–D
foundation vents..... 301–K
foundation walls..... 406–F
garage..... 310
lumber..... 408–A
masonry chimneys..... 406–L–4
rooms..... 302–C
piers..... 406–H
storage space..... 302–C–6
wire, electric..... 702
wood members..... App. A
Skylights, bathroom..... 301–E–2
Slab, concrete on ground:
bed for..... 406–E
driveway..... 406–E–7, 804
floor..... 406–E
garage..... 406–E–5, 419
heat loss and insulation..... 406–E–3, App. E–II
terrace and porch..... 406–E–6
wall..... 406–E–7, 806
Slate shingles..... 411–F

Slope:
basement floor 406–E–4
finish grading 805
garage floor 406–E–5, 419–A
roof 411–A–1
Sodding 806
Sole plate 408–F–6, 408–G–3
Space, heaters ..... App. E–VII–B
Space requirements:
bathroom 302–C–3
closets 302–C–4
each living unit 302–B
fuel storage 302–C–7
garage 310
general storage 302–C–6
habitable rooms ..... 302–C–2 and 3
heating ..... 302–C–8, App. E–I
kitchen storage 302–C–5
under sloping ceiling 302–B
under stairs 302–B
Span tables for wood ..... App. A
Special conditions 401–D
Special construction 401–I
Special methods and systems of heating 501–F
Specifications 3–A
Splashblocks 413–D
Splicing structural members 408–B–1
Stairs 304–A, 307–B, 408–K
Standards, reference ..... App. C
Steam boilers ..... App. E–V–A
Steam heating system ..... App. E–V–A
Steel, structural 407
Steps:
outside 307–B–8, 406–A–5, 806
railing 307–B, 806
wood construction 408–K
Stokers ..... App. E–X
Storage:
fuel 302–C–7
general 302–C–6
hot water 502
kitchen 302–C–5
oil, tank ..... App. E–IX–C
Street, definition ..... App. B
Stringers, stair 408–K
Structural requirements ..... Sec. 400
Stucco:
exterior finish 410–E
wall frame 408–F–9
Studs:
bearing partitions 408–F
exterior wall 408–F
nonbearing partitions 408–G
Subfloor 408–C–4
Suggested construction details 30
Switches, electric 703–C

T

Table of contents III
Tanks, installation of ..... App. E–IX–C
Termites, protection against 406–E–3, 409
Terrace:
flashing 412–F
floor, concrete 406–E–6
railing 309–B
size 309–A
termite shield 409–F
Test data 16–6, 401–F
Thimbles 406–L–7
Three or more living units, applicable requirements ..... Foreword
Three-way switch, electric 703–C
Ties:
rafter 408–D, 408–E
top plate 408–F–6
Tile:
drain (footing) 406–D
floors 415–C
roofing 411–E
walls ..... 414–B and C
Top plates 408–F–6, 408–G–3
Topsoil ..... 805 and 806
Treads 307–B, 806
Trenches, footing 403–A
Trim, wood:
exterior 410–F
interior 414–E
Trussed construction:
over openings 408–F–5
roof 408–E–4
Types of eligible dwellings 104

U

Unacceptable construction 16, 108
Utility room:
light and ventilation 301–I

V

Valley:
flashing 412–D
rafters 408–E–2
Vapor barriers 301–L, 402–B
Veneer, masonry 406–J
Ventilation 301
Vents:
attic 301–L
chimney flues and vents 503–A
foundation 301–K
Vents and flues, general 501–B–3

W

Wainscot in bathroom 414–C
Walks 806
Walks, concrete construction 406–E–7
Walls:
curtain 406–H–1
definition ..... App. B
dampproofing 406–G, 417 A–6
exterior, finish 410
exterior, masonry 406–I
foundation 406–F
furring 406–I–5

Walls *Continued.*
footings 406–D
garage 419
insulation 402–A
interior finish 414
interior masonry 406–K
lot line or party 104–B, 406–K–3
retaining 801, 805–E, 806
sheathing 408–H
vapor barrier 402–B
veneer, masonry 406–J
wood exterior, framing 408–F
Warm air ducts, gravity and forced ..... App. E–VI–D
Water 107–604
Water heater 502
Water, hot 601–A–4, 502
Water closet 602–A
Water closet compartments, light, and ventilation 301–F
Waterproofing 406–G, 417–A–7
Waterproofed insulation for slab floor 406–E–3
Water supply 107, 604
Way, definition ..... App. B
Weatherstripping 306–A–2
Weepholes 406–J–2
Wells 604
Winders 307–B–5
Window:
finish grade at 303–C, 308
flashing 412–B
framing 408–F
glass 416
Windows, required:
bathrooms ..... 301–E and F
definition ..... App. B
general 301–B
habitable rooms ..... 301–C and D
habitable basement rooms 303–B
laundries 301–H
open basements 301–G
recreation rooms 301–H
utility rooms 301–I
Wire, size, electric . 701–B, 702–B and D
Wire fabric for lath 414–A
Wire mesh 406–E–1, 409–C
Wiring, lay-out, application requirements 2–C
Withes 406–L–5
Wood framing 408
Wood finish:
at finish grade 406–F–2
floors 415–B
exterior plywood 410–D
exterior wood trim 414–E
interior wood trim 414–E
interior plywood 414–D
shingles, roof 411–C
shingles, wall 410–B
siding 410–A
Wood construction:
basementless spaces 403–B
forms for concrete .. 406–B–4, 406–F–2
garage 419
protection against termites 409
sheathing, roof 408–J
sheathing, wall 408–H
subflooring 408–C–4
Wood grounds (for plaster) 408–F–5
Wood painting 408–J–2, 410–D–4, 410–A–5, 417
Wood preservative treatment 409–E
Wood shims 308–F–4
Wood sleepers 415–B
Workmanship 401–G

Y

Yards, definition ..... App. B
Yards 203, 204, 205, 206

Z

Zoning 200–B

U. S. GOVERNMENT PRINTING OFFICE: O—1954

FEDERAL HOUSING ADMINISTRATION
Washington, D. C.

October 1954

MPR REVISION NO. 50

To Holders of FHA Publication "Minimum Property Requirements for Properties of One or Two Living Units":

The following revision to the captioned book is applicable in all insuring office jurisdictions, and shall be made effective within 60 days:

405-B Aggregates. Revise to read as follows:

1. Fine aggregate for concrete: Natural sand or sand prepared from stone, gravel or blast-furnace slag; free of excessive organic and other deleterious substances.

2. Fine aggregate for mortar: Natural sand, clean, well-graded and free of excessive organic and other deleterious substances.

3. Coarse aggregate for concrete: Crushed stone, gravel, blast-furnace slag or other inert materials of similar characteristics free from excessive amounts of deleterious substances.

4. Fine and coarse aggregates for concrete shall be furnished and batched as separate materials.

5. The size and grading of fine and coarse aggregates for concrete shall conform to the requirements of "Tentative Specifications for Concrete Aggregates", (ASTM Designation: C 33-52-T), or "Tentative Specifications for Lightweight Aggregates for Structural Concrete", (ASTM Designation: C 330-53-T) of the American Society for Testing Materials. **

6. The maximum size of coarse aggregate shall be not less than three-fourths inch nor greater than:
   a. Three-fourths of minimum clear spacing between reinforcing bars.
   b. Three-fourths of the clear space between main reinforcing and forms.
   c. One-fifth of the narrowest dimension between sides of forms.

7. See 406-B-2-e.

406-B Concrete Work. Revise 406-B-1 and 406-B-2 to read as follows:

1. General
   a. Materials. See 405.
   b. Reinforced concrete work shall comply with Building Code Requirements for Reinforced Concrete (ACI 318-51), of the American Concrete Institute.
   c. Air-entrained concrete may be used and is desirable for concrete exposed to freezing and thawing. Unless plant or transit-mix concrete is used, air-entrained concrete shall be obtained by the use of cement to which an air-entraining agent has been added by the cement manufacturer.
   d. Retempering of concrete that has partially hardened by mixing, with or without additional cement or water, will not be permitted.

2. Concrete Mixes

(State Strength in Specifications. For example: 2000, 2500, 3000 or 3500 psi.)

a. Concrete shall have a compressive strength of at least 2000 pounds per square inch and a cement content of not less than 5 sacks per cubic yard.

b. Mixing water shall normally be not more than that required to produce a slump of 4 inches, but in no case shall mixing water exceed 7-1/2 gallons per bag of cement, including free moisture contained in the aggregates, or that required to produce a slump of 6 inches, when tested with a standard slump cone (ASTM C 143-52),** whichever is less.

c. Proportions of cement, fine and coarse aggregate, and mixing water shall be such as to produce a mixture which will work readily into the corners and angles of the forms and around the reinforcement with the methods of placing employed on the work, but without permitting the materials to segregate or excess free water to collect on the surface.

d. For field mixing operations, where aggregates are measured by volume, in a damp and loose condition, the following approximate proportions will produce plain concrete meeting minimum requirements:

Size of Coarse Aggregate	Approximate Cement, Sacks Per Cubic Yd.	Approximate *Water, Gals. Per Sack	Maximum Slump in Inches	Approximate Volumetric Proportions per Sack of Cement in Cubic Feet		
				Cement	Fine Agg.	Coarse Agg.
Concrete Subject to Freezing and Thawing						
3/4 in. to No. 4	6	5	6	1	2-1/2	2-3/4
1 in. to No. 4	5.8	5	6	1	2-1/2	3
1½ in. to No. 4	5.4	5	6	1	2-1/2	3-1/2
2 in. to No. 4	5.2	5	6	1	2-1/2	4
Concrete Not Subject to Freezing and Thawing						
3/4 in. to No. 4	5.8	5-1/2	6	1	2-3/4	2-3/4
1 in. to No. 4	5.6	5-1/2	6	1	2-3/4	3
1½ in. to No. 4	5.2	5-1/2	6	1	2-3/4	3-1/2
2 in. to No. 4	5.0	5-1/2	6	1	2-3/4	4

*This Amount of Water is in Addition to Water Normally Contained in Damp Aggregatea.

e. Mixes and materials not in conformance with the requirements used in 405-B and 406-B shall not be used, except when evidence satisfactory to the Chief Underwriter is submitted, which indicates that the end result will be equal in all respects to that achieved by the above requirements.

f. Compressive Tests: The Chief Underwriter may require periodic tests of compressive strength of concrete, made at the expense of the builder, as evidence that concrete meets design strength requirements. When required, compressive tests shall be made, in accordance with applicable Standard Test Methods of the American Society for Testing Materials,** of at least three 6 x 12 inch test cylinders molded on the job, or three cores drilled from representative construction. The average compressive stress of the test specimens shall not be less than the design strength of the concrete, and in no case less than 2000 lbs. per square inch.

**ASTM Specifications are obtainable from the American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa.

Supersedes MPR Revision No. 44

MPR REVISION NO. 51

HEATING REQUIREMENTS

MINIMUM PROPERTY REQUIREMENTS

FOR PROPERTIES OF

ONE OR TWO LIVING UNITS

APPLICABLE IN ALL INSURING OFFICE AREAS

EXCEPT HONOLULU AND SAN JUAN

OCTOBER 1954

FEDERAL HOUSING ADMINISTRATION

WASHINGTON 25, D. C.

MPR REVISION No. 51
HEATING REQUIREMENTS
OCTOBER 1954

To holders of FHA Publication "Minimum Property Requirements for Properties of One or Two Living Units":

The following revision to the captioned book is applicable in all insuring office jurisdictions except Honolulu and San Juan.

All items which are in the nature of "relaxations" are effective immediately. All items which are of a "more restrictive" nature shall be made effective not later than January 1, 1955.

Sections 500–510 supersede Sections 500–503 C and Appendix E of the Minimum Property Requirements.

Section 520 supersedes Section 502 of the Minimum Property Requirements and/or MPR Revision No. 44 dated July, 1953.

TABLE OF CONTENTS

General Requirements	500
Corollary Items	501
Heat Loss Calculations	502
Capacity of Heating Equipment	503
Rating, Construction and Accessories	504
Firing Equipment	505
Design and Installation of Piped Distribution Systems	506
Warm Air Systems	507
Installation of Self-Contained Heating Units	508
Electrical Heating	509
Installations Using Liquefied Petroleum (L-P) Fuel	510
Domestic Water Heating and Storage	520
General Heating References	iii
Index	iv

HEATING REQUIREMENTS

500. OBJECTIVE. *The objective of heating requirements is to assure winter comfort by means of facilities providing a quality of performance as well as economy and convenience of operation appropriate to the dwelling under consideration.*

500–A. General. Each living unit shall be provided with facilities for heating. All equipment and materials shall be new, and equipment shall be clearly marked to permit identification of manufacturer and model. At the time of final inspection, equipment and appurtenances shall be installed in permanent location, connected to required electrical, plumbing, venting, and fuel supply facilities within the property and, where provided, connected to heat distribution system.

500–B. Pertinent Construction. Sections 301–I (Utility Rooms), 301–J (Heater Rooms), 302–C–7 (Fuel Storage), 302–C–8 (Space for Heating), 401–A through K (General, Construction Requirements), 402–A (Insulation), 402–B (Vapor Barriers), 406–E (Concrete Slabs on Ground), and 406–L (Masonry Chimneys) contain requirements pertinent to heating systems.

500–C. Special Methods. Any proposed equipment, materials, or methods of construction related to heating systems and not covered in these requirements shall be considered "special". In such cases, the data to be submitted and the procedure to be followed for determining acceptability are described in FHA Technical Circular No. 4, Parts I, II, or III for the item involved.

500–D. Construction and Installation. Unless otherwise acceptable to the Chief Underwriter or modified herein, the construction and installation of all equipment, accessories, and appurtenances shall comply with local laws and ordinances, and with the applicable current published standards, requirements, and recommendations of the National Fire Protection Association, National Board of Fire Underwriters, American Standards Association, and the American Society of Mechanical Engineers.

1. *Labeling and Listing.* Labeling and/or listing of equipment and accessories by the Underwriters' Laboratories, Inc., American Gas Association, or the American Society of Mechanical Engineers; Commercial Standard labeling; or certification by the manufacturer in accordance with an applicable Commercial Standard will be accepted as conforming with equipment design standards.

NOTE.—*See current Underwriters' Laboratories "Gas and Oil Equipment List," "Electrical Equipment List," AGA "Directory of Approved Gas Appliances and Listed Accessories," and ASME "Boiler Codes."*

500–D. Construction and Installation—*Continued.*

2. *Reduced Clearances.* Equipment proposed for installation with clearances to combustible construction less than permitted by the National Building Code (NBFU), or in other locations requiring special precautions not covered by the general requirements of section 500–D, shall be listed by Underwriters Laboratories or American Gas Association and installed within the conditions and limitations of such listing.

3. *Access Clearance.* Adequate clearances shall be provided from all equipment and operating devices for access, maintenance, repair, replacement, and proper operation.

4. *Combustion Air.* Where heating equipment is intended for installation in alcoves, closets, small heater rooms, attics, or crawl spaces, adequate provision shall be made for combustion air and space ventilation.

NOTE.—*For oil-fired equipment—see National Building Code; for gas-fired equipment—see Pamphlet No. 54, National Fire Protection Association.*

500–E. Solid Fuel Burning Equipment. Solid-fuel-burning equipment shall not be installed above the first story. Hand-fired equipment shall have a check damper and turn damper installed in the smokepipe unless included as an integral part of the heating unit. The turn damper shall have not less than 20 percent free opening when in the closed position.

501. COROLLARY ITEMS.

501–A. Chimney, Vent, or Flue. The construction and installation of chimneys, vents, and flues shall comply with the National Building Code except as otherwise provided herein.

Combustion gases from heating equipment using solid or liquid fuel, and vented equipment using gaseous fuel, shall be discharged above the roof through a masonry chimney, or a flue or vent listed by Underwriters Laboratories for the fuel used.

Flues or vents serving gas-fired equipment shall be equipped with a specially designed cowl or cap to prevent downdraft. Any opening in a vent cap shall be not less than 1 foot in a vertical direction, nor less than 4 feet in a horizontal direction, from any part of the roof or building structure.

501–B. Vent or Flue Connectors, and Smokepipes. Vent or flue connectors (for gaseous fuel), and smokepipes (for liquid or solid fuels) shall comply with the National Building Code except as otherwise provided herein.

Connectors and smokepipes shall have a free area not less than the outlet provided on the connected equipment, and where serving more than one piece of equipment the combined connector shall have an area not less than the largest individual connector plus 50 percent of the area of any additional connectors. Connectors and smokepipes shall have a slope upward toward the chimney or vent of not less than 1 inch in 4 feet, and where connected to a chimney be provided with a thimble or sleeve.

1. *Smokepipes for Equipment Burning Solid or Liquid Fuel* shall (1) where necessary be fitted with cleanouts; (2) have a maximum horizontal

length of 10 feet from equipment outlet to chimney or flue; and (3) shall be constructed of iron or steel of a gage not less than the following:

Diameter	*Gage*
Up to 12 inches	24
12 inches to 16 inches	20
16 inches to 20 inches	18
20 inches to 30 inches	16
Over 30 inches	14

2. *Flue Connectors for Equipment Burning Gaseous Fuel,* shall have a maximum length from equipment outlet to chimney or vent not exceeding 75 percent of the vertical height of the chimney or vent. The materials used for flue or vent connectors shall be resistant to corrosion and be of sufficient thickness to withstand damage.

501–C. Controls. Operating, and limit or safety control devices, which are not tested as an integral part of an appliance shall be listed as separate devices by AGA or Underwriters Laboratories.

501–D. Barometric Dampers and Draft Hoods. Oil-fired and stoker-fired equipment, except as otherwise listed by Underwriters Laboratories, shall be provided with a Underwriters Laboratories-listed barometric-type draft regulator.

Vented gas-fired appliances, except incinerators, dual-oven-type combination ranges, and units designed for power burners or forced venting, shall be provided with an AGA-listed draft hood.

501–E. Fuel Oil Tanks and Piping. Installation of fuel-oil tanks, piping, and oil burners shall comply with the requirements in the current edition of NBFU Pamphlet No. 31, "Standards for the Installation of Oil-Burning Equipments."

1. *Gravity Oil Supply.* Installations using gravity oil supply to burner shall be equipped with a constant-level device, or otherwise arranged to prevent abnormal discharge of oil at the burner.

2. *Tank Size and Location.* Oil supply tanks inside of buildings shall not (1) be installed above the lowest story; (2) be located within 5 feet horizontally of any fire, flame, or other probable source of ignition; and (3) exceed 275 gallons' individual capacity or 550 gallons' aggregate capacity.

502. HEAT LOSS CALCULATIONS. Calculations of heat loss shall be in accordance with the data and procedures indicated in the current edition of the "Guide" of the American Society of Heating and Ventilating Engineers.

Simplified methods, such as developed in the appropriate Guides of the Institute of Boiler and Radiator Manufacturers (IBR), or the applicable manuals of the National Warm Air Heating and Air Conditioning Association (NWAH and ACA) may be used, provided the results obtained are in substantial agreement with, and not less than, those obtained by using the data and procedures contained in the ASHVE Guide. FHA publications such as MPR Information Series Bulletin "Calculation of Heat

502. Heat Loss Calculations—*Continued.*

Loss" and Technical Circular No. 7, "Calculation of Building Section Heat Transmission Coefficients," may be used as acceptable reference sources.

In case of any variation or disparity in transmission coefficients, design temperatures, or other criteria or data, the final determination of acceptability will be made by the Chief Underwriter.

503. CAPACITY OF HEATING EQUIPMENT.

503–A. *The heat emission* of radiators, convectors, baseboard radiation, panels, registers, or other terminal devices of heat distribution systems shall be not less than the calculated heat loss of the space which they are intended to heat.

503–B. *The net output of boilers,* or the *bonnet output of furnaces* (with deductions for duct losses and pickup) shall be not less than the calculated heat loss of the space served.

503–C. Input and Output of Boilers and Furnaces.

1. *Boilers.*

a. *Input* is the calorific value of the fuel supplied per hour to develop the rated output capacity.

b. *Gross output* in B. t. u. per hour is the output as determined when operating within the limitations and conditions stipulated in the applicable rating code.

c. *Net output* in B. t. u. per hour is the gross output less allowance for jacket, pickup, and piping losses as provided in the applicable rating code.

2. *Furnaces.*

a. *Input* is the calorific value of the fuel supplied per hour to develop the rated output capacity.

b. *Bonnet output* in B. t. u. per hour is the amount of heat available at the furnace bonnet at rated capacity and does not include jacket radiation, or allowances for pickup and duct losses.

503–D. *The heat output of a self-contained heating unit* (see sec. 504 for method of rating), such as a room heater, space heater, wall heater, floor furnace, or vented recessed heater, for the purpose of sizing to meet the calculated heat loss of any building or part thereof served by the unit, shall be determined on the following basis:

	Top of all supply outlets 18 inches or less from floor	*Top of all supply outlets 5 feet or less from floor*	*Top of any suppiy outlet more than 5 feet from floor*
Not equipped with fan.....	Use rated output.	Reduce rated output 8 percent.	Reduce rated output 12 percent.
Equipped with fan.....	Use rated output.	Reduce rated output 5 percent.	Reduce rated output 10 percent.

NOTE 1.—*Circulating fans installed as an integral part of self-contained heating units shall have a capacity (1) of not less than 6 c. f. m. per 1,000 B. t. u. output of the appliance, or (2) sufficient to prevent a temperature rise through the device of more than 100° F. when operating at rated capacity, for the unit to be considered "Equipped with fan."*

NOTE 2.—*The maximum rated output of self-contained units "Not equipped with fan" shall be 47,700 B. t. u. per hour. The maximum rated output of units "Equipped with fan" shall be 52,700 B. t. u. per hour.*

504. RATING, CONSTRUCTION AND ACCESSORIES.

504–A. Boilers.

1. *Rating.* Input, output, and net ratings of boilers shall be obtained from—

a. Current "I–B–R Ratings for Boilers" (Cast Iron), published by the Institute of Boiler and Radiator Manufacturers.

b. Current "SBI Rating Code," published by the Steel Boiler Institute.

c. Current "Net Load Recommendations for Heating Boilers," published by the Heating Piping and Air Conditioning Contractors National Association.

d. Current "Directory of Approved Appliances and Listed Accessories," published by American Gas Association.

2. *Construction.* The construction of hot water or steam heating boilers shall comply with applicable provisions in the current edition of "Code for Low Pressure Heating Boilers," published by American Society of Mechanical Engineers.

3. *Accessories.*

a. Each steam boiler, when installed, shall be equipped with—

(1) A pressure relief valve bearing the ASME Code symbol, and capacity markings in compliance with the applicable provisions of the current edition of the ASME Code for Low Pressure Heating Boilers. B. t. u. relief capacity shall be not less than the gross output rating of the boiler.

(2) A steam gage, and a water gage glass with gage cocks.

(3) A low water cutoff, when the boiler is automatically fired.

(4) A combustion regulator which will prevent the generation of steam pressures in excess of 15 p. s. i.

b. Each hot water boiler, when installed, shall be equipped with—

(1) A pressure relief valve bearing the ASME Code symbol, and capacity markings in compliance with the applicable provisions of the current edition of the ASME Code for Low Pressure Heating Boilers. B. t. u. relief capacity shall be not less than the gross output rating of the boiler.

(2) A pressure or altitude gage and thermometer.

(3) A combustion regulator which will prevent the generation of boiler water temperatures in excess of 250° F.

4. *Boiler Insulation.* Each boiler shall be provided with thermal insulation which shall be securely attached to the boiler or casing. The conductance of the insulating material plus any protective casing used shall not exceed 0.50 B. t. u. per hour per square foot per degree F. between surfaces of boiler and casing.

504–B. Warm Air Furnaces.

1. *Gravity Warm Air Furnace.* The bonnet output in B. t. u. per hour shall be—

a. Coal burning, hand-fired or stoker-fired; and oil or gas conversion burners—

504–B. Warm Air Furnaces—*Continued.*

(1) With secondary heating surface of at least five times the grate area, and

(a) With any ratio of total heating surface to grate area from 15 to 1, to 25 to 1, inclusive—not more than 1,785 times the heating surface in square feet times 1.33.

(b) With a ratio of total heating surface to grate area greater than 25 to 1—not more than 1,785 × 25 grate area in square feet times 1.33.

(2) Without secondary heating surface, or with secondary heating surface less than five times the grate area, and with a ratio of total heating surface to grate area of at least 15 to 1—not more than the grate area in square inches times 1.33 times the factor opposite the applicable ratio in the following table:

Ratio	B. t. u. per square inch of grate area	Ratio	B. t. u. per square inch of grate area	Ratio	B. t. u. per square inch of grate area
15–1	156	21–1	220	26–1	267
16–1	167	22–1	230	27–1	272
17–1	177	23–1	241	28–1	276
18–1	188	24–1	251	29–1	281
19–1	198	25–1	262	30–1 and over	286
20–1	209				

b. Oil-fired gravity warm air furnace-burner unit containing a vaporizing type oil burner—not more than that determined in accordance with Commercial Standard CS–104.

c. Oil-fired gravity warm air furnace-burner unit containing a pressure-atomizing or rotary type burner—not more than that determined in accordance with Commercial Standard CS–195.

d. Gas-fired gravity warm air furnace-burner unit—not more than the output rating listed in the AGA "Directory of Approved Appliances and Listed Accessories."

2. *Forced Warm Air Furnaces.* The bonnet output in B. t. u. per hour shall be obtained as follows:

a. Coal burning forced warm air furnace, hand-fired, with bonnet output exceeding 80,000 B. t. u. per hour:

(1) With secondary heating surface at least five times the grate area, and

(a) With any ratio of total heating surface to grate area from 15 to 1 to 25 to 1, inclusive—not more than 2,265 times the heating surface in square feet times 1.177.

(b) With a ratio of total heating surface to grate area greater than 25 to 1—not more than 2,265 × 25 × grate area in square feet times 1.177.

(2) Without secondary heating surface, or with secondary heating surface less than five times the grate area, and with a ratio of total heating surface

to grate area of at least 15 to 1—not more than the grate area in square inches times the factor opposite the applicable ratio in the following table:

Ratio	B. t. u. per square inch of grate area	Ratio	B. t. u. per square inch of grate area	Ratio	B. t. u. per square inch of grate area
15–1	198	21–1	278	26–1	338
16–1	211	22–1	292	27–1	344
17–1	225	23–1	305	28–1	350
18–1	238	24–1	319	29–1	356
19–1	252	25–1	332	30–1 and over	362
20–1	265				

b. Coal burning forced warm air furnace, hand-fired, with bonnet output not exceeding 80,000 B. t. u. per hour—not more than the average bonnet output determined in accordance with the procedure in Commercial Standard CS–109.

This does not apply when the average bonnet output exceeds 80,000 B. t. u.

c. Forced circulation warm air furnace fired by a stoker, oil conversion burner, or gas conversion burner—not more than that as determined for hand firing.

d. Oil fired forced warm air furnace-burner unit containing a vaporizing-type oil burner—not more than that determined in accordance with Commercial Standards CS–104.

e. Oil-fired forced warm air furnace-burner unit containing a pressure-atomizing or rotary burner—not more than that determined in accordance with Commercial Standard CS–195.

f. Gas-fired forced warm air furnace-burner unit—not more than the output rating listed in AGA "Directory of Approved Appliances and Listed Accessories."

3. *Construction and Performance.*

a. Criteria to be used for determining the bonnet output in 504–B–1–a, 504–B–2–a, and 504–B–2–c.

(1) Grate area shall include all portions of movable and stationary grate surfaces that are perforated for the passage of combustion air.

(2) Primary heating surface is heating suface so constructed and located that it receives the direct radiant rays from the fuel bed or burner flame.

(3) Secondary heating surface is heating surface so constructed and located that it does not receive the direct radiant rays from the fuel bed or burner flame.

(4) Finned or extended surfaces on the exterior of primary and secondary heating surfaces shall be credited as heating surface as indicated in the ASHVE Guide.

504-B. Warm Air Furnaces—*Continued.*

(5) Heating surfaces:

(a) Surfaces below the grate level of coal-burning furnaces shall not be credited as heating surfaces.

(b) Surfaces below the bottom of combustion chamber on conversion oil burners shall not be credited as heating surface.

(c) Surfaces below burner ports on gas conversion burners shall not be credited as heating surface.

b. Cast iron or steel furnaces shall meet the American Standards Association Approval Requirements when gas fired; when oil fired shall bear Commercial Standards labels CS–104 or CS–195 or shall be certified by the manufacturer as meeting CS–104 or CS–195. Coal-fired cast-iron furnaces shall have heating surfaces constructed with a thickness of not less than three-eighths inch at points exposed to high temperautres and not less than one-fourth inch at all other points. Coal-fired steel furnaces shall have not less than No. 10 U. S. gage primary and No. 14 U. S. gage secondary heating surfaces.

c. Except for furnace-burner units listed by AGA or Underwriters Laboratories, heating surface on the suction side of the fan is acceptable only when—

(1) Certified test data show that the temperature rise in the fan bearings will not exceed 100° F., and that the temperature of air at fan inlet will not exceed 120° F. when the furnace is operated at rated output.

(2) In the absence of certified test data indicating compliance with (1) above, the actual measured area of heating surface on the suction side of the fan does not exceed 30 percent of the total heating surface.

(3) Such surface is constructed of material at least as durable as required for the primary heating surface of the combustion chamber.

(4) All joints between secondary and primary surfaces are welded or made tight with a bolted gasket external to the furnace casing on the suction side of the fan.

(5) The smokepipe extension, if any, is an integral part of the secondary surface, extends outside the casing, and is constructed of the same material as the primary heating surface.

d. The fan in a forced warm air furnace shall have a capacity of at least 9.2 c. f. m. per 1,000 B. t. u. furnace bonnet output against a static pressure resistance external to the furnace of—

(1) 0.12 inch for an input less than 80,000 B. t. u. per hour when equipped with air filter and 0.20 inch when not equipped.

(2) 0.15 inch for an input of 80,000 to 100,000 B. t. u. per hour when equipped with air filter and 0.23 inch when not equipped.

(3) 0.20 inch for an input of 100,000 to 200,000 B. t. u. per hour when equipped with air filter and 0.28 inch when not equipped.

e. Filter racks and filters, when provided, shall be such that the average air velocity through the filters will not exceed 300 f. p. m. when the fan is delivering the cubic feet per minute required by (d) above. Filters shall be

located so that the temperature of the filters will be not more than 90° F. above the return air temperature when the furnace is operated at rated output. Filters and racks shall be arranged to prevent bypass of the return air. Filters shall not be installed in any gravity, or in hand-fired forced warm air furnaces that burn coal.

f. Every hand-fired solid-fuel burning forced warm air furnace shall be provided with—

(1) A barometric draft control permanently set to limit the draft to a maximum of 0.10 inch of water, or the minimum recommended by the furnace manufacturer, whichever is lower.

(2) An automatic damper regulator connected to a warm air temperature limit control which is located on the furnace and as near as practicable to the supply ducts, or in the beginning of the main supply duct. The limit control shall be designed so that it cannot be set higher than 250° F. The damper regulator shall operate to open the check damper and to close the ash-pit draft damper when the heated air reaches the temperature at which the limit control is set, and shall be of a type which will automatically check the furnace in event of power failure, or which will automatically check the furnace when the limit temperature is reached whether or not power is available.

g. Every forced warm air furnace shall be equipped with a temperature-actuated fan control. The control shall cause the fan to operate when air in the supply plenum or in the beginning of the main supply duct reaches the temperature of the upper limit setting of the control and continue to operate until the temperature of the air has dropped below the lower limit setting of the control. The fan control shall be so constructed that the upper limit setting cannot be above 200° F. A manual disconnect switch shall not be installed in the fan electrical circuit unless such switch cuts off the fan and burner simultaneously.

h. Every automatically fired warm air furnance shall be equipped with a temperature-actuated limit control. This control shall cause the fuel supply to the burner or stoker to be entirely cut off or reduced to pilot-fire or low-fire stage when the air in the supply plenum, or in the beginning of the main supply duct, reaches the temperature of the upper limit setting of the control and shall not permit high-fire conditions to be resumed until the air temperature has dropped below the lower limit setting of the control. The control shall be so constructed that the upper limit cannot be set above 250° F.

504–C. Space Heaters or Room Heaters.

1. *Coal Fired.*

a. The construction shall comply with TS–3443 except that—

(1) Minimum thickness of cast-iron combustion chamber sections or in parts in contact with flue gases shall be not less than one-fourth inch.

(2) Minimum thickness of steel in combustion chamber or in parts in contact with flue gases shall be not less than No. 20 U. S. gage. Steel

504–C. Space Heaters or Room Heaters—*Continued.*

combustion chamber shall be lined up to the top of the fuel-bed level with refractory material having a minimum thickness of 1 inch.

2. *Oil Fired.*

a. The gross output shall be the B. t. u. per hour output determined in accordance with Commercial Standard CS–101.

b. Oil-fired space or room heaters shall be listed by Underwriters Laboratories, Commercial Standard labeled, or certified by the manufacturer as conforming to CS–101.

3. *Gas Fired.*

a. The gross output in B. t. u. per hour shall be—

(1) Not more than 65 percent of the input rating, when less than 20,000 B. t. u. per hour, listed in AGA "Directory of Approved Appliances."

(2) Not more than 70 percent of the input rating, when 20,000 B. t. u. per hour or more, listed in AGA "Directory of Approved Appliances."

b. Gas-fired room or space heaters shall be listed by AGA and installed in accordance with NFPA Pamphlet No. 54.

c. In areas where the use of unvented gas-fired bathroom heaters is the usual practice, such heaters may be accepted, provided—

(1) The AGA-listed input to the heater, in B. t. u. does not exceed 30 times the bathroom volume in cubic feet.

(2) Two openings are installed to ventilate the bathroom, one placed high in wall, door, or ceiling and one placed low in wall, door, or below door. Free area of each opening to be not less than 1 square inch (2 square inches if screened) for each 1,000 B. t. u. input rating of the heater.

504–D. Recessed or Wall Heaters.

1. *Oil Fired.*

a. The gross output in B. t. u. per hour shall be determined from certified test data submitted by the manufacturer and acceptable to the Chief Underwriter.

b. The heater shall be listed by Underwriters Laboratories.

2. *Gas Fired (Vented Recessed Heaters).*

a. The gross output in B. t. u. per hour shall be as determined in 504–C–3–a.

b. The heater shall be listed by AGA and installed in accordance with NFPA Pamphlet No. 54.

504–E. Floor Furnaces.

1. *Oil Fired.*

a. The gross output shall be the B. t. u. per hour output determined in accordance with Commercial Standard CS–113.

b. The floor furnace shall be listed by Underwriters Laboratories, Commercial Standard labeled, or certified by the manufacturer as conforming to CS–113.

2. *Gas Fired.*

a. The gross output shall be as listed in AGA "Directory of Approved Appliances."

b. The floor furnace shall be listed by AGA, Commercial Standard labeled, or certified by the manufacturer as conforming to Commercial Standard CS–99. Installation shall conform to NFPA Pamphlet No. 54.

504–F. Duct Furnaces. Duct furnaces shall be listed by Underwriters Laboratories or AGA, and installed within the limitations of such listing.

505. FIRING EQUIPMENT.

505–A. Conversion Oil Burners.

1. *Mechanical Draft* burners shall bear a Commercial Standard CS–75 label.

2. Heating units equipped with *Vaporizing Type Burners* shall bear the applicable Commercial Standard label, or be certified by the manufacturer as conforming to the applicable Commercial Standard.

3. *The Firing Rate* of any oil burner shall not exceed the recommended burner capacity designated on the boiler or furnace in which it is installed.

505–B. Conversion Gas Burners.

1. Conversion gas burners shall be listed by AGA and installed in accordance with NFPA Pamphlet No. 54.

2. The firing rate of conversion gas burners shall not exceed the recommended burner capacity designated on the boiler or furnace in which it is installed.

505–C. Stokers.

1. *The Maximum Coal Burning Rating* in pounds per hour shall be not less than—

$$\frac{\text{Gross output of furnace or boiler in B. t. u. per hour}}{0.60 \times \text{calorific value of coal used}}$$

2. *The Minimum Coal Burning Rating* in pounds per hour shall be not more than—

$$\frac{0.25 \times \text{heat loss of dwelling in B. t. u. per hour}}{0.60 \times \text{calorific value of coal used}}$$

3. *Anthracite Coal Stokers* shall be constructed in accordance with Commercial Standard CS–48.

506. DESIGN AND INSTALLATION OF PIPED DISTRIBUTION SYSTEMS.

506–A. General.

1. *The Heat Output of Cast Iron Radiators* (free-standing) shall be determined in accordance with "Simplified Practice Recommendation for Cast Iron Radiators R174," issued by the National Bureau of Standards.

2. *The Heat Output of Convectors* shall be as determined in conformity with Commercial Standard CS–140, except that any addition made to published capacities for "Heating Effect" shall be deducted.

3. *The Heat Output of Baseboard Radiation* shall be determined in conformity with the applicable I–B–R Testing and Rating Code, except that any addition made to published ratings for "Heating Effect" shall be deducted.

506–A. General—*Continued.*

4. *Shutoff Valves and Dampers.* Radiators, convectors, and baseboard radiation located in bedrooms shall be provided with an accessible shutoff valve or damper, or otherwise arranged to provide a reduction in heat output.

5. *Balancing.* Accessible means shall be provided for balancing the distribution of heat to the various heated spaces. When a shutoff valve or damper is combined with a balancing device, the balancing device shall provide a balanced distribution of heat for the maximum opening of the shutoff valve or damper. Single-circuit or series-loop systems for single residences, where the heat emission unit or units are sized to within 5 percent of the calculated heat loss of the spaces served, may be installed without balancing devices.

6. *Wall Insulation.* Walls back of recesses for radiators and convectors, and walls back of surface-mounted baseboard radiation elements shall be insulated to the height of the heating element with a material having a conductance not exceeding 0.67 B. t. u. per hour per square foot per degree F. Recessed baseboard heating elements shall be separated from stud spaces, extending from bottom to top of heating element, by an insulating material having a conductance not exceeding 0.67 B. t. u.

7. *Boiler Shutoff and Drain.* Boilers shall be connected to the cold-water supply with a shutoff valve and shall be provided with a drain cock with hose connection. Pressure reducing valves, where used, shall be installed between the shutoff valve and the boiler.

8. *System Drain.* Systems other than panel type shall be installed and arranged to be drained by gravity. Panel systems may be drained by the use of air pressure where gravity drainage cannot be obtained.

9. *Pipe Insulation.* Supply and return piping in unheated attic spaces, ventilated crawl spaces, and other exposed locations shall be insulated to prevent excessive heat loss. The type and thermal value of the insulating materials used should be commensurate with the conditions of exposure and local design temperature difference. Insulation may be omitted from piping in crawl spaces which have ground surface treatment and vents complying with 301–K–2–b, vent closures operable from the outside, and with enclosing foundation walls insulated to provide a "U" factor (above the exterior grade) not exceeding that required for walls in 402–A–2–b.

506–B. Hot Water Systems and Steam Systems.

1. *Design and Installation* shall be in accordance with a recognized and acceptable method such as contained in the ASHVE "Guide," or I–B–R Installation Guides. Submitted drawings shall show calculated heat loss in each space, piping layout and sizing, expansion tanks, air relief devices, balancing cocks, type and emission rate of radiation or convection units, and other pertinent details sufficient to permit a review for checking compliance with recommended practices.

2. *Panel Hot Water Systems.*

a. *Maximum Panel Emission.*

(1) Floor panels: 50 B. t. u. per hour per square foot of panel area, except in bathrooms, entrance halls, and areas within 18 inches of exterior walls, where the maximum may be 60 B. t. u.

(2) Ceiling panels: 60 B. t. u. per hour per square foot of panel area for 7′ 6″ ceilings, 70 B. t. u. for 8′ 0″ ceilings, and 75 B. t. u. for ceilings over 8′ 0″.

b. *Limiting Temperatures.*

(1) Floor panels: 85° F. maximum surface temperature.

(2) Ceiling panels: 120° F. maximum surface temperature; 140° F. maximum water temperature.

(3) Maximum design temperature drop, 20° F.

c. *Reverse Losses and Insulation.*

(1) The reverse (upward flow) loss from a ceiling panel through conventional joist and double wood floor construction to a heated space above may be assumed as 0.25 of the average output of the ceiling panel.

(2) When the spaces above and below a radiant panel in an intermediate floor are in different living units, the floor on the reverse side of the panel shall be insulated with materials having a thermal resistance not less than 7.40. The reverse loss may then be disregarded.

(3) When the space above a ceiling containing a panel is unheated, the ceiling shall be insulated on the reverse side of the panel to provide a transmission coefficient not exceedeing 0.08 B. t. u. The reverse loss from the panel to the unheated space may be assumed as 0.15 of the average output of the panel.

(4) When a concrete slab contains a panel, perimeter insulation in accordance with MPR Section 406–E–3–c shall be installed. Perimeter heat loss may be determined as indicated in the ASHVE "Guide."

d. Balancing. A balancing cock shall be provided for each sinuous coil or grid circuit and identified to indicate the circuit controlled.

e. Coils. Panel coils or grids shall be constructed of copper tubing, or steel or wrought-iron pipe. All piping in panels shall be of the same material, and any exposed connections between piping of dissimilar metals should be made with an insulated joint. Screwed joints shall not be used for any piping or tubing imbedded in concrete or plaster.

507. WARM AIR SYSTEMS.

507–A. General—Gravity and Forced Circulation.

1. *Construction and Installation* shall comply with current standards of the National Board of Fire Underwriters (Pamphlet No. 90, or National Building Code), except as otherwise provided herein.

a. A minimum clearance of 6 inches shall be maintained between the furnace, plenum chamber, or that portion of any duct or extended plenum which receives radiant heat from the furnace, and combustible material. This clearance may be reduced when the furnace unit has been tested and

507–A. General—Gravity and Forced Circulation—*Continued.*
approved for lesser clearances, or when one of the specified forms of protection listed in Pamphlet No. 90 or the National Building Code is installed.

b. For forced warm air furnaces having a limit control with a top setting not exceeding 200° F., portions of ducts and extended plenums, which do not receive radiant heat from the furnace, shall be separated from combustible material by an airspace of at least five-sixteenths inches, up to a distance of 6 feet from the furnace. Beyond 6 feet from the furnace no clearance is required. In lieu of the five-sixteenths inch airspace, the ducts may be covered with incombustible insulating material of a cellular type at least one-fourth inch thick.

2. Provide a *Shutoff Damper* in each supply register located in a kitchen or bedroom, and a shutoff damper in each return grille located in a kitchen.

3. Provide a *Balancing Device* such as a turn damper, stackhead damper, or adjustable maximum opening register valve to control the air distribution to each outlet. Turn dampers shall be adjustable, locking, and have an operating handle that will indicate the position of the damper blade.

4. *Recirculated Air.* Return air from any living unit shall not be recirculated and delivered to any other living unit.

5. *Return Inlets* shall be provided in such number and locations that air being returned from any room in which there is no return inlet can enter a return inlet without passing across the floor of any normally occupied portion of any other habitable room. Return air moving toward a return inlet located in or near the ceiling shall not be considered to be passing across the floor. A return inlet shall not be provided in a bathroom, a garage, a space used for fuel or other storage, or in a confined space in which a draft diverter or draft regulator is located.

6. *Duct Insulation.* Supply and return ducts in unheated attic spaces, ventilated crawl spaces, on the cold side of stud spaces in exterior walls which contain a duct, and in other exposed locations shall be insulated to prevent excessive heat loss. The type and thermal value of the insulating materials used should be commensurate with the conditions of exposure and the local design temperature difference. Insulation may be omitted from ducts in crawl spaces which have ground surface treatment and vents complying with 301–K–2–b, vent closures operable from the outside, and with enclosing foundation walls (above the exterior grade) insulated to provide a "U" factor not exceeding that required for walls in 402–A–2–b.

7. *Hand-Fired Warm Air Systems* shall be protected from the hazard of overheating by:

a. Omit filters in furnace.

b. Omit register valves in registers serving the living room and bathrooms.

507–B. Gravity Warm Air Systems. *Design and Installation* shall be in accordance with a recognized and acceptable method such as contained in the ASHVE "Guide," or applicable code and manual of the National Warm Air Heating and Air Conditioning Association for the type of system involved.

507–C. Forced Circulation Warm Air Systems.

1. *Design and Installation* shall be in accordance with a recognized and acceptable method such as contained in the ASHVE "Guide," or applicable code and manual of the National Warm Air Heating and Air Conditioning Association for the type of system involved, except as otherwise provided herein.

2. *Perimeter Warm Air Heating.*

a. Noncombustible material shall be used in the construction of the supply plenum, supply ducts in the slab less than two-duct diameters from the supply plenum, risers to supply outlets and the horizontal connection to risers for a distance of two-duct diameters from the riser, and supply and return ducts above the floor. Material used in constructing the remainder of the ducts cast in, or under, the floor slab shall be acceptable to the Chief Underwriter.

b. Concrete slab-on-ground construction having heat ducts in or under the slab shall be provided with a continuous vapor barrier membrane installed under the slab and heat ducts.

c. Heat ducts installed in or under concrete slabs shall be completely encased in not less than 2 inches of concrete, except when the duct material is concrete pipe, clay pipe, or asbestos-cement pipe. Galvanized sheet metal ducts shall be not less than 26 gage, coated on the outside of the duct with asphalt or bituminous coating complying with Federal Specification SS–A–701.

d. All ducts in or under slabs should be installed to slope slightly toward the plenum chamber, and the bottom of all ducts shall not be lower than the grade exterior to the foundation wall unless otherwise acceptable to the Chief Underwriter.

3. *Crawl Space Supply and Return Plenum.* Crawl space may be used as a supply or return plenum only in single story structures complying with the following:

a. The ground surface in the crawl space shall be covered with an acceptable type vapor barrier membrane, such as smooth surface roll roofing weighing at least 55 pounds per 108 square feet complying with Federal Specification SS–R–501a. Ground cover material shall have joints lapped at least 3 inches and not sealed.

b. The surface of the ground cover material shall be not less than 18 inches, and not more than 24 inches below the bottom of floor joists and beams.

c. The perimeter construction enclosing the crawl space shall be sealed above the level of the crawl-space ground elevation against air leakage. Parging, covering with membranous material, or other suitable means shall be used.

d. The perimeter wall above crawl-space grade shall be insulated on the interior with nonorganic, water and fungi resistant material to obtain an

average heat transmission coefficient not greater than that of the exterior walls of the structure.

e. Access to the crawl space shall be provided through an opening not less than 18 by 24 inches fitted with a tight cover. Such openings, where practicable, shall be located and arranged to discourage use of the crawl space for storage purposes.

f. Two vent openings in the perimeter wall, equipped with closures operable from the outside, located for effective cross-ventilation, and having a ventilating area at least 10 percent of that required in 301–K–2–a, shall be provided. The vents shall be screened with eight-mesh, corrosion-resistant material.

g. A furnace, boiler, or other heat-generating device, shall not be installed in a crawl space used as a supply or return plenum. The bonnet output of the furnace, boiler, or heating unit shall be not less than the calculated heat loss of the dwelling and of the crawl space under design conditions.

h. Where combustible materials are used in the crawl space, a noncombustible receptacle shall be provided under each floor-type supply register or return grille. Receptacles may be permanently fixed metallic pans or other devices acceptable in the Chief Underwriter.

4. *Crawl Space Supply Plenum.*

a. The heating unit shall be automatically fired with liquid or gaseous fuel, and if of a counterflow or downflow type, shall be equipped with temperature limiting devices in supply and return plenums.

b. Stub supply ducts, connected to plenum, shall be provided in the crawl space. Ducts shall be directed toward supply registers and terminate not less than 5 feet from the plenum. The ducts shall discharge horizontally and the top of each duct shall be not less than 1 inch below joists and beams. Longer ducts may be required to properly direct air toward remote registers.

c. High sidewall outlets may be used only in bathrooms and kitchens.

d. Registers shall be sized to provide a free area velocity through such registers of not more than 500 f. p. m.

5. *Crawl Space Return Plenum.*

a. The heating unit shall be automatically fired with liquid or gaseous fuel.

b. Return inlets to crawl-space plenum shall be sized so that free area velocities through grille will not exceed 500 f. p. m.

508. INSTALLATION OF SELF-CONTAINED HEATING UNITS.

508–A. General. When self-contained heating units, such as room or space heaters, floor furnaces, and vented recessed heaters, are intended to heat spaces other than the room or space in which the device is located, the following requirements shall apply:

1. The distance between the heater outlet and the center of any space to be heated by it shall not exceed 18 feet (20 feet for kitchens), measured through the center of intervening openings. The above distances may be increased by 5 feet in areas having an outside design temperature of +20° F. or higher.

2. There shall not be more than 1 doorway and 1 archway between the heater outlet and any space or room to be heated by it.

3. A return inlet shall not be located in a bathroom, in a space used for fuel or other storage purposes, or in a confined space in which a draft regulator is located.

4. Heating units located in halls where all openings are provided with doors, or in other limited areas which may confine the heat output of the device, shall be provided with thermostatic control or other air temperature limiting device arranged to shut off the fuel supply.

508–B. Heater Outlets. Self-contained heaters having a single warm-air outlet shall not be equipped with a damper or valve designed to restrict the flow of air from the unit. Heaters having two or more outlets shall not be equipped with dampers or valves designed to close off more than 50 percent of the total area of all outlets.

508–C. Dual Supply or Return. Dual supply outlets or return inlets shall be arranged so that vision through the outlets or inlets between adjacent rooms, or rooms and halls, is not possible.

508–D. Passageway. An unobstructed passageway, not less than 2 feet in width, shall be provided on at least one side of a flat register floor furnace or pipeless furnace to permit passage without stepping over or on the register.

508–E. Register Location. Registers of pipeless furnaces and flat register floor furnaces shall not be placed closer than 6 inches to any wall. Wall register floor furnaces shall not be placed closer than 6 inches to a wall corner. Floor furnaces and other self-contained heaters shall be placed so that a door in the open position, or draperies and similar combustible materials, cannot be closer than 12 inches to the register.

509. ELECTRICAL HEATING.

509–A. General.

1. All heat-generating and emission units, and all control devices, shall be listed by Underwriters Laboratories and installed in compliance with local ordinances and the National Electrical Code.

2. Evidence shall be submitted that adequate electrical service will be available and provided by the local utility company. The labeled voltage of equipment shall be within 5 percent of the service voltage provided.

3. The total rating (or adjusted rating) of the heat emission devices in each space shall equal or exceed the calculated heat loss.

509–A. General—*Continued.*

4. The estimated electrical consumption for heating shall be acceptable to the Chief Underwriter. Annual consumption in kilowatt-hours for heating shall be estimated by the following formula:

$$F=\frac{H\times D}{Td\times 170}$$

The terms in the formula are defined as follows:

F=estimated annual electrical consumption in kilowatt-hours.

H=total calculated heat loss of dwelling in B. t. u. per hour at design conditions.

D=average recorded annual degree days for the location involved.

Td=temperature difference in degrees F. between inside and outside design conditions.

NOTE.—*The adjusted B. t. u. rating* $=3413\times\frac{(Service\ voltage)^2}{(Label\ voltage)^2}$.

5. Unless otherwise indicated, the installation recommendations contained in the ASHVE "Guide" and those of the manufacturer should be followed.

509–B. Electric Panel Heating—Resistance Cable.

1. *Panel Output.* The average panel output required under design conditions shall not exceed 68 B. t. u. per hour per square foot of panel area.

2. *Cables.* All cables shall bear a label identifying the manufacturer and rating of the unit. Cables shall be of standard lengths and shall not be cut or otherwise shortened.

3. *Control.* Thermostatic control shall be provided in each heated space, and the wattage rating of the cables shall not exceed the rating of the controlling thermostat and relay combination.

4. *Thermal Insulation.* The heat transmission coefficient of ceilings above panels exposed to unheated spaces above shall not exceed 0.06 B. t. u.

509.–C. Electric Panel—Prefabricated Conductive Materials.

1. Panels shall be thermostatically controlled and have maximum surface temperatures of 120° F.

2. Panels shall not be cut, and lighting fixtures shall not be fastened or cut into the active area of the panel.

3. The heat transmission coefficient of ceilings above panels exposed to unheated spaces above shall not exceed 0.06 B. t. u.

509–D. Air Heaters, Surface Mounted or Wall Insert, Gravity and Fan Type.

1. *Radiant Glass Heaters.*

a. Heaters shall be installed on exterior walls, except in kitchens, bathrooms, and halls, where they may be installed on interior partitions. Radiant glass heaters shall not be installed in floors or ceilings.

b. The upper edge of the mounting frame shall not be greater than 36 inches from the floor.

c. Thermostatic control shall be provided in each heated space.

2. *Convection-Resistance Units.*

a. Each unit shall be provided with thermostatic control.

b. Gravity type shall be installed on exterior walls.

c. Reverse flow, wall-duct type units shall be installed on interior partitions.

3. *Bathroom wall insert heaters* shall be provided with an individual control switch integral with unit, or located within the room and as far as practicable from plumbing fixtures.

510. INSTALLATIONS USING LIQUEFIED PETROLEUM (L–P) FUEL.

510–A. Design and Installation shall be in accordance with NFPA Pamphlet No. 52.

510–B. Availability of Natural Gas. In those areas where natural or manufactured gas is likely to become available, gas piping systems should be designed and installed in accordance with NPFA Pamphlet No. 54 and appliances should be of a type that are readily convertible to the use of natural or manufactured gas.

DOMESTIC WATER HEATING AND STORAGE

520. Objective. *The objective of domestic water heating and storage requirements is to provide an adequate supply of hot water, appropriate to the dwelling under consideration.*

520–A. Facilities. Each dwelling shall be provided with new, durable, and economical facilities for supplying year-around domestic hot water. Equipment shall be installed so as to permit ready access for repair and replacement and shall be completely connected and in safe operating condition at time of final inspection.

520–B. Capacities. Storage capacity and recovery rate shall be appropriate to the type, class and size of dwelling proposed and fixtures and equipment to be served. Tanks, other than those made of monel metal or copper, of less than 30 gallons capacity shall not be accepted, except that for a one-bedroom, one-bathroom unit a 20-gallon tank may be accepted.

520–C. Controls and Safety Requirements.

1. *Electric and oil- or gas-fired water heaters,* except indirect heaters connected to the house heating boiler, shall be AGA or UL listed and labeled.

2. *All storage tanks* shall be provided with AGA listed, labeled, and BTU rated or ASME labeled and BTU rated temperature- and pressure-relief valves (separate or combined), except that a temperature-relief valve may be omitted when the storage tank is indirectly heated or where the water heating device is equipped with an AGA or UL listed, automatic, emergency energy (gas, oil or electricity) shutoff of the manual reset type (in addition to the operating control). The temperature-relief valve or combination temperature- and pressure-relief valve shall be placed in the top of the tank or in the hot water discharge, directly above the tank served, and in no case more than three inches away from the tank, and shall be set to dis-

520–C. Controls and Safety Requirements—*Continued.*

charge at a temperature not in excess of 210° F., and shall have a rated capacity in excess of the burner input capacity. The pressure relief (either separate or combined) shall be set to discharge at least ten pounds per square inch above the highest normal static water pressure. Where a separate pressure-relief valve is used it shall be conveniently located on a hot water line or on the cold water inlet to the tank between the tank and the shutoff valve. There shall be no check valve or shutoff valve between a relief valve and the tank for which it is installed or on the discharge line from the valve.

3. *In the absence of specific applicable requirements* regarding water heaters all matters of fire safety and compliance with provisions of NBFU, AGA and UL; Commercial standards; clearance from combustible construction; flues, vents, and connections thereto; dampers and draft diverters; fuel storage and piping and electric wiring shall be as required for house heating equipment of equivalent burner capacity. Vent all fuel-burning water heaters.

4. *Domestic water heating surface,* exposed to direct flames or hot gases in a furnace or boiler used for house heating, is not acceptable.

520–D. Hot Water Storage Tanks.

1. *Tests.* Storage tanks shall be constructed to withstand a minimum of 300 pounds-per-square-inch test pressure without leakage or permanent distortion and shall bear the manufacturer's marking showing test and working pressure, except that such a marking is not required for AGA or UL listed water heater units.

2. *Materials.*

a. Galvanized storage tanks shall be hot-dipped with a coating of not less than 1½ ounces per square foot each side of surface.

b. When water conditions demand, the Chief Underwriter may require monel metal or copper tanks; ferrous tanks lined with glass, cement, or other acceptable lining material; or cathodic protection.

3. *Insulation.* Storage tanks shall be insulated with material having an overall conductance not greater than 0.30 BTU/sf/hr/degree (¾" mineral wool or equal). Surface of insulation shall be inherently resistant to or protected from mechanical damage.

GENERAL HEATING REFERENCES

Directory of Approved Gas Appliances and Listed Accessories	A. G. A.
Heating, Ventilating, and Air Conditioning Engineers' Guide	A. S. H. V. E.
A. S. M. E. Code for Low Pressure Heating Boilers	A. S. M. E.
Domestic Burners for Pennsylvania Anthracite (Underfeed Type)	C. S.–48
Automatic Mechanical Draft Oil Burners Designed for Domestic Installations	C. S.–75
Gas Floor Furnaces—Gravity Circulating Type	C. S.–99
Flue-Connected Oil-Burning Space Heaters Equipped With Vaporizing Pot-Type Burners	C. S.–101
Warm Air Furnaces Equipped With Vaporizing Pot-Type Burners	C. S.–104
Solid-Fuel-Burning Forced-Air Furnaces	C. S.–109
Oil-Burning Floor Furnaces Equipped With Vaporizing Pot-Type Burners	C. S.–113
Testing and Rating Convectors	C. S.–140
Warm Air Furnaces Equipped With Pressure Atomizing or Rotary-Type Oil Burners	C. S.–195
Proposed Commercial Standard (Emergency) for Coal-Burning Space Heaters	T. S.–3443
I–B–R Ratings for Boilers (Cast Iron) and Baseboards (All Types)	I. B. R. M.
I–B–R Installation Guide No. 1—One-Pipe Forced Circulation Hot Water Heating Systems	I. B. R. M.
I–B–R Installation Guide No. 2—One-Pipe Steam Heating Systems	I. B. R. M.
I–B–R Installation Guide No. 3—Indirect Water Heaters	I. B. R. M.
I–B–R Installation Guide No. 5—Baseboard Heating Systems	I. B. R. M.
I–B–R Installation Guide No. 6—Panel Heating for Small Structures	I. B. R. M.
Net Load Recommendations for Heating Boilers	H. P. & A. C. C. N. A.
National Building Code	N. B. F. U.
Standards for the Installation of Oil-Burning Equipment	N. B. F. U.–31
Standards for the Installation of Air Conditioning, Warm Air Heating, Air Cooling and Ventilating Systems	N. B. F. U.–90
Liquefied Petroleum Gas Piping and Appliance Installation in Buildings	N. F. P. A.–52
Standards for the Installation of Gas Piping and Gas Appliances in Buildings	N. F. P. A.–54
Warm Air Perimeter Heating as Applied to Structures Without Basements—Manual 4	N. W. A. H. & A. C. A.
Gravity Code and Manual for the Design and Installation of Gravity Warm Air Heating Systems—Manual 5	N. W. A. H. & A. C. A.
Code and Manual for the Design and Installation of Warm Air Winter Air Conditioning Systems—Manuals 7 and 9	N. W. A. H. & A. C. A.
Small Pipe Warm Air Perimeter Heating—Tentative Manual 10	N. W. A. H. & A. C. A.
Gas and Oil Equipment List	U. L.
Electrical Equipment List	U. L.

A

Acceptability of heating system___ 500
Access, heating equipment_____ 500–D
Air, combustion_____ 500–D–4
Air ducts, heating_____ 507

B

Balancing, heat distribution___ 506, 507
Barrier, vapor_____ 402–B, 507–C
Barometric damper_____ 501–D
Baseboard radiation_____ 503–A, 506–A
Boiler, heating_____ 504–A
  Accessories_____ 504–A–3
  Construction _____ 504–A
  Insulation _____ 504–A–4
  Rating _____ 504–A–1
Bonnet output, heating furnaces__ 503, 504–B
Breeching, smoke_____ 501–B
Burner:
  Gas conversion_____ 505–B
  Oil conversion_____ 505–A

C

Calculation, heat loss_____ 502
Capacity, domestic hot water storage _____ 520–B
Chimney, flues and vents_____ 406–L, 501, 501–B
Clearance, heating equipment_ 302–C–8, 500–D
Coal-burning equipment_____ 500–E, 504, 505–C
Coefficient, heat transmission____ 502
Concrete floor slab, insulation___ 406–E, 506–B
Construction, heating equipment_ 500–D, 504
Controls:
  Domestic hot water_____ 520–C
  Heating equipment_____ 501–C, 504, 506, 507, 508
Convectors and radiators_ 503–A, 506–A
Conversion:
  Gas burners_____ 505–B
  Oil burners_____ 505–A
Crawl space, warm air plenum__ 507–C
  Ground cover_____ 502, 507–C
  Heat loss_____ 507–C–3

D

Dampers, heating system_____ 501–D, 504–B, 507
Design:
  Electrical heating_____ 509
  Heating systems_____ 500
  Hot water systems_____ 506
  Special methods_____ 500–C
  Steam systems_____ 506
  Temperatures_____ 502
  Warm air systems_____ 507
Domestic water heating and storage_____ 520
Draft controls, heating_____ 501–D, 504
Drains, boiler_____ 506–A–8
Ductwork (heating):
  Clearances _____ 507–A
  Design_____ 507
  Insulation_____ 507–A–6
  Material_____ 507–A–1

E

Electric:
  Domestic water heating_____ 520–C
  Heating_____ 509
Emergency energy shutoff, domestic water heaters_____ 520–C–4
Equipment, heating_____ 500

F

Facilities, heating_____ 500
Fans, heating furnaces_____ 504
Filters, warm air system_____ 504–B
Firing equipment_____ 505
Floor furnaces_____ 504–E, 508
Floor heat loss_____ 502
Flues and vents_____ 501
Flue connectors_____ 501
Forced warm air:
  Furnaces_____ 503, 504–B
  Heating systems_____ 507

Fuel limitations 500–E
Fuel oil:
Burners 505
Piping and tanks 501–E
Furnaces:
Bonnet output 503–B, 503–C
Construction and rating 504–B
Floor 504–E, 508
Forced warm air 503, 504–B
Gravity 503, 504–B
Installation 500–D

G

Gas, domestic water heaters 520–C–1
Gas heating equipment:
Conversion burner 505–B
Floor furnace 504–E, 508
Recessed or wall heater 504–D, 508
Space heater 504–C, 508
Warm air furnace 504–B

H

Hand-fired heating equipment 500–E, 504
Heat insulation, heating systems 504–A, 506–A, 507, 509
Heat loss calculation 502
Heaters:
Clearances 302–C–8, 500–D
Domestic water 520
Recessed or wall 504–D, 508
Space or room 504–C, 508
Heating:
Boilers 503, 504–A
Equipment capacity 503
Equipment clearances 500–D
Hot water 506–B
Panel 506, 509
Requirements 500
Special methods 500–C
Steam systems 506
System design 506
Warm air furnaces 503, 504–B
Warm air systems 507

I

Infiltration heat loss 502
Inside design temperature 502
Input:
Boiler 503–C, 504–A
Furnace 503–C, 504–B
Installation of heating equipment 500–D, 501
Insulation:
Boiler 504–A
Heating system 506, 507
Slab on ground 406–E–3, 506–B

L

Labeling:
Domestic water heaters 520–C–1
Heating equipment 500–D
Safety devices—domestic water heaters 520–C–4
Listing:
Domestic water heaters 520–C–4
Heating equipment 500–D
Safety devices—domestic water heaters 520–C–4
Limitations, heating equipment 500–D
Location:
Domestic water heaters 520–A
Heating equipment 500–D
Low water cutoff, boiler 504–A

M

Mechanical draft oil burner 505–A
Mechanical equipment, heating 500

N

Net output, definition 503–C
Net rating, boilers 503, 504–A

O

Oil:
Burner 505–A
Domestic water heater 520–C–1
Gages 501–E
Heating equipment 500
Piping and storage tanks 501–E
Ordinances, local 200–B, 300–B, 401–C, 500–D, 501–A, 701–B
Output, heat 503
Outside design temperature 502

P

Perimeter:
Heating 507–C
Insulation 406–E–3, 506–B
Pipe:
Fuel oil 501–E
Gas 500–D, 510
Heating 506
Panel hot water 506–B–2
Plenum, warm air 507–C
Pressure gage, boiler 504–A

Pressure relief, domestic water heating_____ 520–C–4
Pressure relief valve, boiler_____ 504–A

R

Radiation, baseboard____ 503–A, 506–A
Radiator and convector:
Heat output_____ 503–A, 506–A
Recesses_____ 406–I–9, 506
Rate, firing (heating equipment)_ 505
Rating:
Boiler net_____ 503
Heating equipment_____ 503, 504
Recirculated air_____ 507–A
Recovery rate, domestic water heaters _____ 520–B
Registers, warm air_____ 507
Regulators:
damper_____ 504
Pressure combustion_____ 504–A
Relief valve:
Boiler _____ 504–A
Domestic water heaters_____ 520–C–4
Return air ducts_____ 507

S

Safety, heating equipment_____ 500–D
Safety devices, domestic water heaters _____ 520–C–4
Safety valve, boiler_____ 504–A
Self-contained heating units_503, 504, 508
Slab on ground, heat loss and insulation_____ 406–E–3, 506–B
Smoke breeching_____ 501–B
Solid fuel burning equipment___ 500–E, 504
Space heaters_____ 503–C, 504–C, 508
Special methods of heating_____ 500–C
Steam boiler_____ 504–A
Steam heating systems_____ 506
Stokers_____ 505–C
Storage, fuel oil_____ 302–C–7, 501–E
Storage tank, domestic hot water:
Insulation _____ 520–D–3
Materials _____ 520–D–2
Tests_____ 520–D–1

T

Tanks, fuel oil_____ 501–E
Temperature:
Boiler water_____ 506–B
Design_____ 502
Temperature control, heating____ 504
Temperature relief, domestic water heaters _____ 520–C–4
Thermometer, hot water boiler__ 504–A
Transmission coefficient, heat loss_ 502

U

U factors_____ 502
Underground oil tanks_____ 501–E
Units, heating_____ 500
Unlabeled heating equipment___ 500–D

V

Valves:
Fuel oil_____ 501–E
Safety _____ 504–A, 520–C–4
Vapor barriers_____ 402–B, 507–C
Vents:
Domestic water heaters_____ 520–C–5
Heating equipment_____ 501
Oil tank_____ 501–E

W

Wall heater_____ 503, 504–D, 508
Warm air heating:
Furnaces_____ 503, 504–B
Systems_____ 507

☆ U. S. GOVERNMENT PRINTING OFFICE : 1954 O — 319493

FEDERAL HOUSING ADMINISTRATION
Washington, D. C.

MPR REVISION NO. 52

March 1955

To Holders of FHA Publication "Minimum Property Requirements for Properties of One or Two Living Units:

The following revision to the captioned book is applicable in all insuring office jurisdictions except Honolulu and San Juan and shall be made effective immediately. This revision supplements MPR Revision No. 51 relating to heating requirements.

501-A. Chimney, Vent or Flue. Delete the last paragraph and add the following:

All flues, vents and chimneys shall extend at least 2 feet above the highest point where they pass through the roof of the building and at least 2 feet higher then any roof ridge or parapet wall within 10 feet.

Flues or vents serving gas-fired equipment shall be provided with a specially designed cap when the design of the vent is such that the entrance of rain. or leaves, paper and other debris may cause the vent, or the appliance connected thereto, to become unsafe for use. Flues not provided with caps shall be designed to prevent rain water from accumulating in any flue passage or discharging into the flue connector.

503-D. Delete in its entirety.

504-B-3-g. Change to read:

g. Every forced warm air furnace shall be equipped with a temperature-actuated fan control. The control shall cause the fan to operate when air in the supply plenum (or any supply duct), or in the return plenum (or any return duct) reaches the temperature of the maximum fan setting of the control and continue to operate until the temperature of the air in the supply plenum or duct reaches the lower fan setting.

The fan control shall be so constructed that the maximum fan setting cannot be above 200°F. Except for gas-fired furnaces equipped with self-generating controls, a manual disconnect switch shall not be installed in the fan electrical circuit unless such switch also cuts off the burner.

504

~~503~~-B-3-h. Change to read:

h. Every automatically fired warm air furnace shall be equipped with a temperature-actuated limit control. The control shall cause the fuel supply to the burner or stoker to be entirely cut off, or reduced to pilot-fire or low-fire stage when the air in the supply plenum (or any supply duct), or return plenum (or any return duct) reaches the maximum limit setting of the control. The control shall be so constructed that the maximum setting will not permit air temperatures exceeding 250°F in the supply or return plenums, except that downflow (counterflow) and horizontal furnaces, and furnaces installed in alcoves and closets shall be limited to 200°F.

504-C-3. Change to read:

3. Gas Fired.

a. The gross output of vented heaters in Btu per hour shall be--

(1) Not more than 65 percent of the input rating, when less than 20,000 B.t.u. per hour, listed in AGA "Directory of Approved Appliances."

(2) Not more than 70 percent of the input rating, when 20,000 B.t.u. per hour or more, listed in AGA "Director of Approved Appliances."

b. Gas-fired room or space heaters shall be listed by AGA and installed in accordance with NFPA Pamphlet No. 54.

c. In areas where the use of unvented gas-fired bathroom heaters is the usual practice, such heaters may be accepted, provided--

(1) The AGA listed input to the heater, in Btu does not exceed 30 times the bathroom volume in cubic feet.

(2) Ventilation opening or openings are installed to provide a total free area of not less than 2 square inches (4 square inches if screened) for each 1,000 Btu input rating of the heater.

507-A-1-b. Change to read:

b. For forced warm air furnaces having a limit control with maximum setting that limits the discharge air temperature to 200°F., portions of ducts and extended plenums, which do not receive radiant heat from the furnace, shall be separated from combustible material by an air space of at least five-sixteenths inches, up to a distance of 6 feet from the furnace. Beyond 6 feet from the furnace no clearance is required.

508-A-4. Change to read:

4. Heating units located in halls where all openings are provided with doors, or in other limited areas which may confine the heat output of the devices, shall be provided with an air temperature limiting device arranged to shut-off the fuel supply. This control shall not be located in a space that is separated by a door from the space which receives the main discharge air from the heating unit.

508-A-5. Add new 5 to read as follows:

5. The total calculated hourly heat loss of any building or part thereof served by a self-contained heating unit (see Section 504 for Method of Rating), such as a room heater, space heater, wall heater, floor furnace, or recessed heater shall not exceed 45,000 Btu when heating unit is not equipped with fan, or 50,000 Btu when heating unit is equipped with fan. Circulating fans installed as an integral part of self-contained heating units shall have a capacity (1) of not less than 6 cfm per 1,000 Btu output of the appliance, or (2) sufficient to prevent an air temperature rise through the device of more than 100°F. when operating at rated capacity, for the unit to be considered "Equipped with fan."

FEDERAL HOUSING ADMINISTRATION
Washington, D. C.

MPR REVISION NO. 53

July 1955

To Holders of FHA Publication "Minimum Property Requirements for Properties of One or Two Living Units":

The following revisions to the captioned book are applicable in all insuring office jurisdictions, shall be made effective immediately (except as noted below), and shall replace previous requirements relating to the subjects covered.

Note: Items marked with asterisk shall be made effective not later than 90 days after issuance.

* 310. Change to read:

310. When garages and carports are included, minimum size (inside to face of studs or posts.)

	1 Car	2 Car
Width	10' 0"	18' 4"
Length	20' 0"	20' 0"

401-J. Change to read:

401-J. Final Acceptance. Before final acceptance, all buildings shall be complete and ready for occupancy, with all equipment installed. All utility connections shall be made, and service available unless assurances are provided that such connections and service will be available upon occupancy.

405-E-6. Add new sentence to read:

* 6. All concrete block shall conform to specifications listed for concrete block in Appendix C.

406-A-4-a to f inclusive. Change to read:

a. All rafter plates shall be anchored to masonry walls. Wood frame wall construction, in areas subject to seismic disturbance, shall be anchored in all cases. In other areas, anchorage of wood frame wall construction may be omitted when a wood joist floor system is employed. When required, minimum anchorage as follows:

(1) 1/2" bolts, with nuts and washers, embedded in masonry unit walls and piers not less than 12 inches; in poured concrete, not less than 6 inches. Spacing, 8 feet o. c. maximum with at least two bolts in each piece. In masonry unit walls and piers, install plate approximately 3 inches square at head of bolt, embedded in masonry joint; or

(2) Hardened steel studs driven by power actuated tools, size and spacing to be determined by Chief Underwriter

408-F-3-a. Change to read:

a. Braces shall be installed at all external corners exceptas provided for in d below. Use 1 x 4's let into face of studs, sill and plate, set at 45° extending from bottom of sill to top of plate. Use two 8d nails at each bearing. (This item now in Maryland, Virginia and District of Columbia MPR).

410-F-4. Change to read:

4. Nailing: Set face nails and seal with putty after application of prime coat of paint, unless hot-dipped galvanized or aluminum nails are used.

411-H-1-a; 412-A-2; 413-B-2. Delete ". . . painted on exposed surfaces, etc. . . "

413-A. Change to read:

413-A. Gutters and downspouts shall only be required where soil conditions, drainage of surface water, eave flashing, etc., on each specific property shall produce a condition resulting in dampness, flooding, erosion or other damage by surface or ground water.

Statement preceding paragraph 415-A. Change to read:

Finish floors shall be installed except that plywood or other hard surfaced material acceptable to the Chief Underwriter may be installed as flooring if evidence satisfactory to the Chief Underwriter is submitted which indicates that wall to wall carpeting is to be furnished. Carpeting is not acceptable as a part of the realty. See 408-C-4-d.

417-A-5. Change to read:

5. Exposed galvanized sheet metal shall be prepared for painting by priming with zinc dust - zinc oxide primer or other treatment to assure adhesion of paint. One additional coat of paint shall be applied over zinc dust - zinc oxide primer and two coats of paint over other treatment. See 411-H, 412-A and 413-B.

417-B-4. Add new paragraph to read as follows:

4. Ornamental iron, structural steel, steel sash and miscellaneous steel and iron shall be painted with at least one coat of paint in addition to shop coat.

417-E. Metal. Delete 417-E-1 and 2.

GPO 896586

Supersedes
MPR Revision No. 49
dated October, 1954

FEDERAL HOUSING ADMINISTRATION
Washington, D. C.

MPR REVISION NO. 54
(August 1955)

To Holders of FHA Publication "Minimum Property Requirements for Properties of One or Two Living Units":

The following revision to the captioned book is applicable in all insuring office jurisdictions except Hawaii and Puerto Rico, and shall be made effective within 90 days.

402-A. Delete and substitute the following:

402-A. Thermal Insulation

1. General. The calculated hourly heat loss from any dwelling at outside design temperature shall not exceed 55 Btu per square foot of floor area.

Note: The floor area shall be measured from the interior surface of exterior walls or partitions exposed to unheated spaces and shall include the area occupied by closets, partitions, walls, and stairs.

2. Electrical Heating. Where the principal source of heat is provided by electric resistance units, the calculated hourly heat loss from the dwelling at outside design temperature shall not exceed 40 Btu per square foot of floor area.

3. Maximum Transmission Coefficients for Walls, Ceilings, and Floors over Crawl Spaces (except electric heat.)

Outside Design Temperature °F	Walls	Ceilings	Floors over Vented Crawl Spaces
-25 and lower	.10	.10	.08
-20 to -24	.12	.12	.10
-15 to -19	.14	.14	.11
-10 to -14	.16	.15	.12
- 5 to - 9	.18	.15	.13
0 to - 4	.20	.15	.14
+ 1 to + 5	.23	.15	.17
+ 6 to +10	.25	.15	.20
+11 to +15	.28	.15	.23
+16 to +20	.32	.15	.26
+21 to +25	.36	.15	.30
+26 and higher	no. insul.	.15	no. insul.

4. Perimeter Insulation for concrete Floors on Ground.

a. Perimeter insulation shall be (1) non-capillary; (2) not permanently harmed by wetting, or by contact with wet concrete mix; (3) not subject to damage by fungi or termites; and (4) shall have a resistance to compression such that; (a) the reduction in thickness under a uniform loading of 50 lbs. per. sq. ft. shall not be more than 10% of its initial thickness; and (b) the additional reduction in thickness under a uniform loading of 90 lbs. per. sq. ft. shall not be more than 6% of the thickness measured under the initial 50 lbs. loading.

b. The thermal value and the width of perimeter insulation shall be as follows:

Outside Design Temp. °F.	Unheated Floor Slab Total Horizontal and/or Vertical Width of Insulation, Feet			Heated Floor Slab Total Horizontal and/or Vertical Width of Insulation, Feet		
	2	1½	1	2	1½	1
	Minimum Conductance of Insulation Btu/sq. ft/Hr/°F					
-30 and lower	0.15	-	-	-	0.30	0.20
-20 to -29	0.20	-	-	0.40	-	0.30
-10 to -19	0.20	-	-	-	-	0.40
0 to - 9	0.30	0.20	0.15	-	-	0.40
⁄ 1 to ⁄10	0.40	0.30	0.20	-	-	0.40
⁄11 to ⁄20	-	-	0.40	Vert. edge of slab only		
⁄21 to ⁄30	Vert. edge of slab only			" " " "		
⁄31 and above	None Required			None Required		
	Summer Air Conditioning					
⁄31 and above	-	-	0.40	-	-	0.40

Note: As used in the Table above, the term "Heated Floor Slab" shall mean any installation such as radiant floor panel, warm air perimeter loop, or warm air perimeter radial type systems where heating pipes or duct are installed in or under the concrete slab.

Insulation Conductivity as Related To
The Thickness and Conductance

Conductivity K	Thickness of Insulation, Inches			
	2	1½	1	3/4
	Insulation Conductance, C			
0.2	0.1	0.13	0.2	0.27
0.25	0.13	0.17	0.25	0.33
0.3	0.15	0.20	0.3	0.4
0.35	0.18	0.23	0.35	0.47
0.4	0.2	0.27	0.4	0.53

5. Loose Fill insulation

a. When roof slope is less than 3 in 12 loose fill insulation may be installed only if provision for installation of attic fan is not made and if ventilation is by means other than eave vents.

b. When roof slope is 3 in 12 or more loose fill insulation shall not be installed if provisions are made for the installation of an attic fan, or if ventilation is by means of eave vents, unless precautions are taken to prevent (1) loss of insulation into the air stream produced by the fan, or (2) plugging of eave vents with insulating material.

6. Insulation shall be labeled as follows:

a. Batt and blanket types not having reflective surfaces-
   (1) Name of manufacturer or national distributor
   (2) Specified thickness in inches

b. Reflective type -
   (1) Name of manufacturer or national distributor.
   (2) Manufacturer's designation as to type and/or number.

c. Combination batt or blanket type with reflective surfaces -
   (1) Name of manufacturer or national distributor.
   (2) Specified thickness in inches.
   (3) Manufacturer's designation as to type and/or number.

Note: Labeling shall be permanently affixed to the insulation at the manufacturer's plant, or printed, stamped or embossed at regular intervals on the insulating material, so that at least one label shall occur for each 40 lineal feet of insulation installed between framing members.

d. Blowing or pouring type -

A card (minimum size 6" x 6") signed by the builder, shall be installed in a prominent location adjacent to the insulation stating -

(1) Name of manufacturer or national distributor and trade name of insulation.

(2) Specified thickness of insulation.

(3) That installed thickness is adequate to maintain specified thickness and insulation has been installed at the manufacturer's recommended density.

(4) Date of installation.

402-B. Vapor Barriers.

402-B-5. Delete and substitute the following:

5. In all cases where walls and ceilings contain materials adversely affected by moisture or by freezing in the presence of moisture, an effective vapor barrier having a vapor permeability of no more than one perm shall be provided on the warm side of the wall or ceiling under the following conditions:

a. When the "U" value for the wall is lower than 0.25 Btu per hour per sq. ft. per degree Fahrenhiet.

b. When the wall has a siding, or a sheathing, or a sheathing paper or any other material on the cold side of the wall which material, as applied, has a water vapor permeability of less than 5 perms (grains per hour per square foot per inch of mercury pressure differential), and the dwelling is located in an area having a design temperature of zero or colder.

c. A vapor barrier membrane having a vapor permeability of not more than one-half perm shall be installed on the warm side of all combination ceiling-roof construction located in areas where the outside design temperature is zero or colder.

d. On the warm side of ceilings below ventilated attic spaces when the construction is located in area having a design temperature of -20 or lower.

506-A-9. Pipe Insulation. Change "402-A-2-b" to read: "402-A."

506-B-2-c. Reverse Losses and Insulation. (4) Change "406-E-3-c" to read: "402-A".

506-B-2-e. Coils. Change to read:

e. Panel coils or grids shall be constructed of copper tubing, steel tubing or pipe, or wrought-iron pipe. All piping in panels shall be of the same material, and any exposed connections between piping of dissimilar metals should be made with an insulated joint. Screwed joints shall not be used for any piping or tubing imbedded in concrete or plaster.

507-A-6. Duct Insulation. Change "402-A-2-b" to read: "402-A."

509-A-4. Change "Note" to read:

Note. Adjusted Btu rating = $3.413 \times \frac{(\text{Service Voltage})^2}{(\text{Label Voltage})^2} \times \text{Input (watts)}$

509-D-1-a. Delete the words: "or ceilings."

GPO 896585

Supersedes
MPR Revision No. 25
dated August, 1951

FEDERAL HOUSING ADMINISTRATION
Washington, D. C.

MPR REVISION NO. 55

July, 1955

To Holders of FHA Publication "Minimum Property Requirements for Properties of One or Two Living Units":

The following revisions to the captioned book are applicable in all insuring office jurisdictions and replace existing requirements relating to concrete slabs on ground.

They shall be made effective within 60 days:

406-E. Concrete Slabs on Ground.

1. Construction

a. Bed under slabs, when required, shall be gravel, sand, or crushed rock, (unless otherwise noted below). Earth under slab bed shall be leveled and tamped.

b. Wire mesh reinforcing, when required, minimum weight 20 pounds per 100 square feet.

c. Maximum tolerance from stated thickness of concrete slab: 1/2 inch.

2. Cement Floor Finish.

a. Surface shall be troweled to a smooth finish.

b. Concrete slab shall have integral finish, or a 1 inch topping of 1 part portland cement, 3 parts sand.

3. Slabs on ground used as a finish floor or as a base for other floor finish in habitable rooms:

a. Minimum thickness, 4 inches.

b. When concrete slab on ground is used as finish floor or the base for other finish flooring in habitable rooms the construction of the floor and base shall be such that water or dampness will not penetrate the slab. Normal construction precautions against water or dampness will require the following under all conditions except where local experience has shown that no water problem will be encountered.

(1) 4-inch thick bed of clean, uniformly graded gravel or crushed stone, drained if below grade. Provisions must be made to prevent cement paste or fines of concrete from filling the voids of the bed.

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7-b below.

6. Terrace and porch floor slabs.

a. Minimum thickness, 4 inches.

b. Metal flashing shall be installed between slabs and all wood construction. See 412-F.

c. Intersection of walls with slabs. Porch and terrace slabs and concrete or masonry steps shall be supported at the intersection by metal anchors, piers or corbels built integrally or bonded to the foundation walls, or a supporting ledge on the foundation wall.

7. Driveways and Walks.

a. Minimum thickness, 4 inches.

b. Expansion joints shall be provided at garage apron and at maximum 80-foot intervals.

c. A trowel cut approximately half-way through the slab of walks shall be made at approximately 4-foot intervals.

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c. When site conditions are such that ground or surface water within one foot of the bottom of the slab is likely, provisions b(1) and b(2) shall be installed. When hydrostatic pressure will occur the construction and waterproofing shall be designed for the specific conditions.

d. Where local experience has shown that water or dampness will not reach the slab under the conditions presented, slab may be placed directly on firm soil or well compacted sand or sand-gravel fill, except that when the slab has heating ducts or heating pipes in or under the slab provisions b(1) and b(2) shall be installed under all conditions. See 507-C-2-b and d.

e. Perimeter insulation. - See 402-A.

f. Maximum depth of fill, if earth, 12 inches; if gravel (bank run or graded) 24 inches, well tamped. Type and depth of fill subject to acceptance by FHA.

g. Bearing partitions and non-bearing masonry partitions.

(1) Thicken slab under bearing partitions and non-bearing masonry partitions to form a beam not less than 8 inches thick and 16 inches wide. Reinforcing in thickened section, when required, to be not less than two 5/8 inch reinforcing bars 3 inches from bottom; or

(2) Install footing and foundation wall on undisturbed soil under partition.

4. Basement floor slabs.

a. Minimum thickness, 3 inches.

b. Bottom of slab shall be not lower than top of footing. Continue slab over footing projection to foundation wall. See detail 1.

5. Garage floor slabs.

a. Minimum thickness, 4 inches.

b. Extend slab at least 2 feet in front of garage door opening to form an apron; slope to driveway. See 7-b below.

6. Terrace and porch floor slabs.

a. Minimum thickness, 4 inches.

b. Metal flashing shall be installed between slabs and all wood construction. See 412-F.

c. Intersection of walls with slabs. Porch and terrace slabs and concrete or masonry steps shall be supported at the intersection by metal anchors, piers or corbels built integrally or bonded to the foundation walls, or a supporting ledge on the foundation wall.

7. Driveways and Walks.

a. Minimum thickness, 4 inches.

b. Expansion joints shall be provided at garage apron and at maximum 80-foot intervals.

c. A trowel cut approximately half-way through the slab of walks shall be made at approximately 4-foot intervals.

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